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526.

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PHELPS, T. S., Commodore. Navy Yard, Mare Island.
PHILIP, J. W., Commander. Comd'g "Ranger."
PICKING, H. F., Commander. Light House Office, Portland, Me.
PIGMAN, G. W., Lieut. Comd'r. "Jamestown."
PILLSBURY, J. E., Lieutenant. "Kearsage."
PLATT, R., Master. Nitre Depot, Malden, Mass.
POOK, S. H., Naval Constructor. Navy Yard, Washington, D. C.
POYER, J. M., Cadet Mid'n. Naval Academy.
PRINDLE, F. C., Civil Eng'r. Navy Yard, New York.
QUEEN, W. W., Captain. Bu. Yards & Docks.
RAE, C. W., P. Asst. Eng'r. Bu. Steam Engineering.
RAE, T. W., Esq. 239 Broadway, New York.
RAMSAY, F. M., Captain. Sup't Naval Academy.
RANSOM, G. M., Commodore. Richfield Springs, N. Y.
READ, G. H., Paymaster. "Fishhawk."
READ, J. J., Commander. Light House Office, St. Louis.
REES, C. P., Lieutenant. "Essex."
REES, J. L., Cadet Mid'n. "Lancaster."
REISINGER, W. W., Lieutenant. Bellevue Magazine.
REITER, G. C., Lieut. Comd'r. Light House Office, Portland, Oregon.
REMEY, E. W., Lieutenant. "Tennessee."
REMEY, G. C., Commander. "Lancaster."
REMEY, W. B., Judge Advocate General. Navy Dept.
RHOADES, W. W., Lieutenant. Torpedo Station.
RICE, J. M., Professor. Naval Academy.
RICH, J. C., Lieutenant. "Enterprise."
RIDER, F. C., Cadet Mid'n. "Quinnebaug."
RIPLEY, C. S., Midshipman. "Brooklyn."
ROBESON, H. B., Commander. Naval Academy.
ROBIE, E. D., Chief Eng'r. Navy Yard, Boston.
ROBINSON, L. W., P. Asst. Eng'r. "Minnesota."
ROBINSON, W. M., Cadet Mid'n. "Lancaster."
RODGERS, C. R. P., Rear Admiral. 1721 I St., Washington, D. C.
RODGERS, J. A., Lieutenant. Navy Yard, Washington, D. C.
RODGERS, W. L., Ensign. "Quinnebaug."

ROELKER, C. R., P. Asst. Eng'r. Bu. Steam Engineering.
ROHRBACKER, J. H., Cadet Mid'n. Naval Academy.
ROLLER, J. E., Master. "Saratoga."
ROOSEVELT, N. L., Esq. 47 William St., New York.
ROSE, F. B., Chaplain. 1706 N. 18th St., Philadelphia.
ROSS, A., Lieutenant. Navy Yard, Washington, D. C.
ROWAN, S. C., Vice Admiral. Governor Naval Asylum.
ROYCE, A. L., Chaplain. "Brooklyn."
RUSH, R., Lieutenant. Naval Academy.
RUSH, W. R., Ensign. "Ranger."
RUTH, M. L., Surgeon. "Essex."
RYAN, T. W., Midshipman. "Saratoga."
SAFFORD, W. E., Cadet Mid'n. "Powhatan."
SAMPSON, W. T., Commander. Naval Observatory.
SANDS, B. F., Rear Admiral. 816 15th St., Washington, D. C.
SARGENT, N., Lieutenant. "Portsmouth."
SAWYER, F. E., Master. "Ashuelot."
SCHAEFER, H. W., Lieutenant. Naval Academy.
SCHOCK, J. L., Cadet Mid'n. "Quinnebaug."
SCHOULER, J., Lieut. Comd'r. Naval Academy.
SCHROEDER, S., Lieutenant. "Despatch."
SCOT, J. A., P. Asst. Eng'r. Navy Yard, League Island.
SEBREE, U., Lieutenant. "Brooklyn."
SELFRIDGE, J. R., Lieutenant. "Portsmouth."
SEMPLE, L., Cadet Mid'n. Naval Academy.
SHARP, A., Master. "Pensacola."
SHAW, C. P., Lieutenant. Charlottesville, Va.
SHEPARD, E. M., Commander. Comd'g "Enterprise."
SHIPLEY, J. H., Midshipman. "Saratoga."
SHOCK, W. H., Engineer-in-Chief. Bu. Steam Engineering.
SICARD, M., Commodore. Bu. Ordnance.
SIGSBEE, C. D., Commander. Hydrographic Office.
SIMPSON, E., Commodore. Comd't Navy Yard, League Island.
SIMPSON, E., Cadet Mid'n. "Richmond."
SKERRETT, J. S., Captain. Comd'g "Richmond."
SMITH, A. E., Cadet Eng'r. "Lackawana."
SMITH, J. A., Pay Inspector. 1906 H St., Washington, D. C.
SMITH, W. D., Chief Eng'r. "Yantic."
SMITH, W. S., Cadet Eng'r. "Pensacola."
SMITH, W. S., Cadet Eng'r. "Brooklyn."
SNYDER, H. L., Chief Eng'r. "Powhatan."
SOLEY, J. C., Lieutenant. "Saratoga."
SOLEY, J. R., Professor. Naval Academy.
SPEED, J. N., P. Asst. Paymaster. "Kearsarge."
SPERRY, C. S., Lieutenant. Naval Academy.
SPEYERS, A. B., Lieutenant. "Saratoga."

SPAGUE, F. J., ENSIGN. European Station.
STAAL, A. W., CADET ENG'R. "Galena."
STAHLE, F. H., CADET MID'N. Naval Academy.
STANTON, J. R., P. ASST. PAYMASTER. Washington, D. C.
STANTON, O. F., CAPTAIN. Naval Asylum.
STAUNTON, S. A., LIEUTENANT. "Swatara."
STAYTON, W. H., CADET MID'N. "Tennessee."
STEVENS, T. H., REAR ADMIRAL. 1214 Conn. Ave., Washington, D. C.
STEVENS, T. H., LIEUTENANT. 1214 Conn. Ave., Washington, D. C.
STEWART, H. H., CHIEF ENG'R. Navy Yard, League Island.
STEWART, R., CADET ENG'R. "Richmond."
STOCKTON, C. H., LIEUT. COMD'R. "Iroquois."
STOCKTON, H. T., LIEUTENANT. "Palos."
STRONG, E. T., LIEUTENANT. Torpedo Station.
STRONG, W. C., LIEUTENANT. Signal Office.
SULLIVAN, J. T., LIEUTENANT. Bu. Navigation.
SUTPHEN, E. W., CADET MID'N. Naval Academy.
SUTTON, F. E., CADET MID'N. "Pensacola."
TANNER, Z. L., LIEUTENANT. Comd'g "Fishhawk."
TAUSSIG, E. D., LIEUTENANT. Naval Academy.
TAYLOR, H. C., COMMANDER. "Saratoga."
TERRY, E., COMMANDER. Santa Barbara, Cal.
TERRY, N. M., PROFESSOR. Naval Academy.
THACKARA, A. M., LIEUTENANT. 718 Chestnut St., Philadelphia.
THOMAS, C., LIEUTENANT. "Adams."
THOMAS, C. M., LIEUT. COMD'R. Naval Academy.
THOMAS, E. B., LIEUT. COMD'R. Comd'g C. S. S. "Bache."
TILLEY, B. F., LIEUTENANT. "Tennessee."
TILLMAN, E. H., MIDSHIPMAN. "Portsmouth."
TILTON, McL., CAPT. U. S. M. C. Navy Yard, Washington, D. C.
TOTTEN, G. M., LIEUTENANT. Washington, D. C.
TRAIN, C. J., LIEUT. COMD'R. "Powhatan."
TRIBON, D. H., CHAPLAIN. "Powhatan."
TRUXTON, W. T., COMMODORE. Norfolk, Va.
TURNBULL, F., LIEUTENANT. Morristown, N. J.
TURNER, T. J., MEDICAL DIRECTOR. National Board of Health.
TURNER, W. H., LIEUTENANT. "Vandalia."
TYLER, A. C., ESQ. Norwich, Conn.
TYLER, G. W., LIEUTENANT. "Tennessee."
UPSHUR, J. H., COMMODORE. Comd't Navy Yard, New York.
VAN DUZER, L. S., CADET MID'N. "Powhatan."
VREELAND, C. E., LIEUTENANT. Nautical Almanac Office.
WADHAMS, A. V., LIEUTENANT. "Nipsic."
WADSWORTH, H., ESQ. 45 Beacon St., Boston.
WAGGENER, J. R., P. ASST. SURG. "St. Marys."
WAINWRIGHT, R., LIEUTENANT. Bu. Navigation.

WALKER, JOHN G., COMMODORE. Chief, Bureau Navigation.
WARD, A., LIEUTENANT. "New Hampshire."
WARING, H. S., MASTER. "Rodgers."
WASHINGTON, R., PAY INSPECTOR. Pay Office, Washington, D. C.
WATSON, E. W., LIEUTENANT. "Franklin."
WEAVER, W. D., CADET ENG'R. "Yantic."
WEBB, T. E., NAVAL CONSTRUCTOR. Navy Yard, Norfolk.
WEEKS, J. W., CADET MID'N. "Richmond."
WELLS, C. H., COMMODORE. Comd't Navy Yard, Portsmouth.
WELLS, H., P. ASST. SURG. Philadelphia, Pa.
WEST, C. H., LIEUTENANT. "Alliance."
WHITE, E., LIEUT. COMD'R. Naval Academy.
WHITE, U. S. G., CIVIL ENG'R. Navy Yard, Boston.
WHITE, W. W., CADET ENG'R. "Adams."
WILLIAMS, W. W., PAY INSPECTOR. "Lancaster."
WILSON, BYRON, COMMANDER. Naval Rendezvous, Philadelphia.
WILSON, H. B., CADET MID'N. "Tennessee."
WILSON, J. C., LIEUTENANT. "Tennessee."
WINDSOR, W. A., P. ASST. ENG'R. Naval Academy.
WINN, J. K., LIEUT. COMD'R. Comd'g Naval Station, Key West.
WINSLOW, F., LIEUTENANT. U. S. Fish Commission.
WINTERHALTER, A. G., ENSIGN. "Jamestown."
WISE, F. M., LIEUTENANT. "Despatch."
WOOD, E. P., LIEUTENANT. Naval Academy.
WOOD, S. S., CADET MID'N. Naval Academy.
WOOD, T. N., 2ND LT. U. S. M. C. Navy Yard, Mare Island.
WOOD, W. M., LIEUTENANT. U. S. Fish Commission.
WOOLFERSBERGER, W. H., CADET MID'N. Naval Academy.
WOOLVERTON, T., SURGEON. Naval Hospital, Philadelphia.
WORDEN, J. L., REAR ADMIRAL. Retiring Board, Navy Dept.
WORTHINGTON, W. F., ASST. ENGINEER. "Lancaster."
WRIGHT, M. F., LIEUTENANT. Naval Academy.
WRIGHT, R. K., MIDSHIPMAN. "Portsmouth."
WYMAN, R. H., REAR ADMIRAL. Washington, D. C.
YATES, A. R., COMMANDER. Navy Yard, Portsmouth.
YATES, I. I., LIEUTENANT. "Franklin."
ZANE, A. V., P. ASST. ENG'R. "Rodgers."

LIFE MEMBERS—5.

HON. R. B. FORBES, Milton, Mass.
COMDR. A. D. BROWN, PRIZE ESSAYIST, 1879. Comd'g "Jamestown."
LIEUT. C. BELKNAP, PRIZE ESSAYIST, 1880. Naval Academy.
LIEUT. E. W. VERY, PRIZE ESSAYIST, 1881. Bu. Ordnance.
LIEUT. J. D. J. KELLEY, PRIZE ESSAYIST, 1882. 13 Park Ave., New York City.

HONORARY MEMBERS—8.

Arranged in order of election.

HON. W. E. CHANDLER, Secretary of the Navy (Ex-officio).
CHIEF JUSTICE C. P. DALY, 11 W. 29th St., New York.
PRESIDENT C. W. ELIOT, LL. D., Harvard University, Cambridge.
CAPTAIN J. ERICSSON, 36 Beach St., New York.
GENERAL U. S. GRANT, New York City.
HON. G. V. TOX, 1651 Penn. Ave., Washington.
PROFESSOR J. E. HILGARD, Superintendent U. S. Coast Survey.
JOHN D. JONES, Esq., Pres. Atlantic Mutual Ins. Co., New York.

ASSOCIATE MEMBERS—22.

ACKLAND, W. A. D., Comd'r R. N. H. B. M. S. "Triumph."
ARTHUR, W., Capt. R. N. Admiralty Office, London.
BAILEY, N. P., Esq. 11 W. 28th St., New York.
BATTEN, A. W. C., Lieut. R. N. Royal Naval Club, Portsmouth, England.
BRENTON, R. O. B. C., Lieut. R. N. H. B. M. S. "Triumph."
BONTELLE, C. O., Assistant, Coast Survey. Norfolk, Va.
BROOKE, J. M., Professor. Virginia Military Institute, Lexington, Va.
CHASE, LESLIE, Esq. 30 Broad St., New York.
FORSTER, E. J., M. D. Charlestown, Mass.
HOFFMAN, J. W., Esq. 259 S. 17th St., Philadelphia.
HUNT, W. P., Esq. South Boston Iron Works.
LYON, HENRY, M. D. Charlestown, Mass.
MENSING, A., Comd'r Imp. German Navy. 2 Bowling Green, New York.
METCALFE, H., Capt. U. S. A. Frankford Arsenal, Philadelphia.
MILLER, H. W., Esq. Morristown, N. J.
MYERS, T. B., Esq. 4 W. 34th St., New York.
NORDHOFF, C., Esq. Alpine, Bergen Co., N. J.
ROPES, J. C., Esq. 53 Temple St., Boston, Mass.
RUSSELL, A. H., 1st Lt. U. S. A. Watertown Arsenal, Mass.
SARGENT, C. S., Professor. Harvard University, Cambridge.
SIMPSON, J. M., Capt. Chilian Navy. Valparaiso, Chili.
WILSON, A. E., Lieut. Chilian Navy. Valparaiso, Chili.

CORRESPONDING SOCIETIES.

United States.

American Academy of Arts and Sciences, Boston, Mass.
American Geographical Society, 11 W. 29th St., New York.
American Institute of Mining Engineers, Easton, Pa.
American Metrological Society, Columbia School of Mines, New York.
American Society of Civil Engineers, 127 E. 23d St., New York.
American Society of Mechanical Engineers, 239 Broadway, New York.
Franklin Institute, 15 S. 7th St., Philadelphia, Pa.

Military Service Institution of the U. S., Governor's Island, New York.
New York Genealogical and Biographical Society, 64 Madison Ave., New York.
The School of Mines Quarterly, 4th Ave. and 49th St., New York.

Foreign.

Association Parisienne des Propriétaires d'Appareils à Vapeur, Paris.
Giomale d'Artiglieria e del Genio, Rome.
Hydrographisches Amt der Kaiserlichen Marine. Berlin.
Institute of Mining and Mechanical Engineers. Newcastle-upon-Tyne.
Institution of Mechanical Engineers. 10 Victoria Chambers, Westminster, London.
Mittheilungen a. d. Gebiete d. Seewesens. Pola.
Réunion des Officiers de Terre et de Mer. 37 Rue de Bellechasse, Paris.
Rivista Marittima. Rome.
Royal United Service Institution. Whitehall Yard, London.
Société des Ingénieurs Civils. 10 Cité Rougemont, Paris.

NECROLOGY.

Chief Engineer Albert Aston. Born, Middletown, Conn., Dec. 29, 1838. Appointed Third Assistant Engineer from Connecticut, Feb. 21, 1861. Office Engineer-in-Chief, April 4, 1861—Nov. 21, 1865. Promoted to Second Assistant Engineer, Dec. 8, 1862, and to First Assistant Engineer, Dec. 1, 1864. Nov. 21, 1865, to the Swatara, West India squadron. June 12, 1866, detached and to special duty, Baltimore, until Nov. 7, when to duty at Bureau Steam Engineering. July 15, 1867, to the Quinnebaug, South Atlantic station; detached July 18, 1870. Special duty connected with boiler experiments, June 30, 1871—Feb. 5, 1874. Promoted to Chief Engineer, July 12, 1873. May 30, 1874, to the Wachusett, Home station; detached Dec. 30. June 4, 1875, to the Omaha, S. Pacific station; detached April 23, 1878. Receiving ship Franklin, Sept. 23, 1878—April 9, 1879. In charge Engineer's stores, Portsmouth Yard, March 19, 1881. Died, Portsmouth, N. H., Sept. 10, 1881. Total sea service, eight years; shore duty, seven years, nine months; in service twenty years, seven months.

Captain Kidder Randolph Breese. Born, Philadelphia, Pa., April 14, 1831. Appointed Midshipman, from Rhode Island, Nov. 6, 1846, and passed examination at Annapolis, Nov. 25. Detached March 9, 1847, and to the Saratoga, Home squadron. March 16, 1848, transferred to the St. Mary's, then to the Brandywine, Brazil squadron. Dec. 6, 1850, detached, and three months leave. Feb. 1, 1851, to the St. Lawrence, European station; Aug. 14, detached. Oct. 1st, to the Naval Academy. June 8, 1852, promoted to Passed Midshipman; June 9, to the Mississippi, Japan expedition. April 25, 1855, detached, and three months leave. July 10, Coast Survey. Nov. 9th, warranted Master, with rank from Sept. 15, 1855. Promoted Lieutenant, Sept. 16, 1855. Nov. 27, detached from the Bibb, and to the Coast Survey Office. May 12, 1856, detached, and to the Bibb. Oct. 24, detached, and to the Coast Survey Office. Dec. 9th, detached, and to the Bibb. Oct. 15, 1858, detached, and to

Preble, Paraguay expedition. Oct. 7, 1859, invalided, three months leave. Nov. 23, 1859, to the Portsmouth, African squadron, taking passage in the Mohican. Aug., 1860, transferred to the San Jacinto; detached Dec. 4, 1861, and to the mortar flotilla. Took part in the attacks on New Orleans and Vicksburg, 1862. Oct. 4, 1862, detached, and to the Mississippi squadron; commanded Blackhawk. April 18, 1863, commissioned Lieutenant Commander, with rank from July 16, 1862. Detached Oct. 6, 1864, and to the N. Atlantic Blockading squadron, as Fleet Captain. Commanded landing party of sailors and marines in the attack on Fort Fisher. May 2, 1865, detached. August 10, to the Naval Academy as Assistant to the Superintendent; detached Sept. 13, 1866. Commissioned Commander July 25, 1866. Nov. 14, special duty, member Board of Examiners of volunteer officers. June 22, 1867, to the Washington Yard as Inspector of Ordnance. July 20, 1869, detached and three months leave. Dec. 1, 1869, member of Ordnance Board. June 29, 1870, detached, and to command the Plymouth, European station; Nov. 26, 1872, detached. Dec. 16, special ordnance duty. June 4, 1873, detached, and to the Naval Academy as Commandant of Midshipmen. Aug. 9, 1874, commissioned Captain. Oct. 31, detached. Dec. 19, to the Coast Survey as Inspector of Hydrography. Detached June 3, 1875, and to command the Torpedo station. Sept. 2, 1878, detached, and to special ordnance duty. Jan. 17, 1879, detached and to command the Pensacola, Pacific station. June 1, 1880, detached and sick leave. Member of Board of Harbor Commissioners, Philadelphia, Feb. 15, 1881. Died, Newport, R. I., Sept. 13, 1881. Total sea service, twenty years, three months; shore duty, twelve years, one month; in service, thirty-four years, ten months.

Paymaster Samuel Tracy Browne. Born, Pawtucket, Rhode Island, March 23, 1837. Appointed Acting Assistant Paymaster, Sept. 30, 1862, from Rhode Island. Oct. 24 to the Montauk, South Atlantic Blockading squadron. July 3, 1863, invalided North. Feb. 5, 1864, to the Onondaga, N. Atlantic Blockading squadron. Appointed Assistant Paymaster in the regular service, March 9, 1865. Detached April 22. March 14, 1866, to the Ashuelot, Asiatic station. May 4, promoted to Passed Assistant Paymaster; March 22, 1867, promoted to Paymaster. March 31, 1869, detached and to settle accounts. Sept. 11, to the Pensacola Yard. Sept. 17, order re-

voked and three months sick leave. April 9, 1870, to Rio de Janeiro as Naval Storekeeper. April 19, 1873, detached and to settle accounts. May 18, 1874, to the Naval Academy as Naval Storekeeper; detached July 2, 1878, and to settle accounts. Oct. 14, six months leave, with permission to leave the United States. June 11, 1879, special duty at Washington, Examining Board; Aug. 9, detached. December 6, 1879, to the Powhatan, Home station. Died on board the Powhatan at Newport, R. I., June 15, 1881. Total sea service, nine years, five months; shore duty, five years, five months ; in service, eighteen years, ten months.

CADET-MIDSHIPMAN CHARLES CABANISS. Born in Petersburg, Virginia, Oct. 14, 1859. Appointed Cadet-Midshipman from Virginia; entered Naval Academy June 21, 1876; graduated No. 22 in a class of 62 members, June 10, 1880. Aug. 17, 1880, to the Swatara, Asiatic station. Accidentally shot and killed, on board ship at Kobé, Japan, January 19, 1882. Total sea service, one year, ten months; shore duty, three years, six months; in service, five years, seven months.

LIEUTENANT FREDERICK COLLINS. Born, Millbridge, Maine, April, 1847. Appointed Midshipman from Maine; entered Naval Academy, July 22, 1863. Graduated June 6, 1867, No. 3 in a class of 87 members. June 10, to the Franklin, European station. Promoted to Ensign, Dec. 18, 1868. Detached and ordered to the Richmond, European station, Jan. 15, 1869; transferred to the Guard; detached Oct. 5. Jan. 4, 1870, to the Guard, Darien Surveying expedition. July 14 promoted to Master, with rank from March 21, 1870. Ordered to Tehuantepec Surveying expedition Sept. 9, but orders revoked Sept. 17, and on sick leave till Oct. 31. Nov. 18 to the Saginaw, Pacific station; transferred to Darien Surveying expedition until April 3, 1871, when to Pacific fleet. July 28 to special duty at Washington connected with the Darien expedition, but granted delay until Nov. 1. Promoted to Lieutenant, March 21, 1871. Special duty with Darien Surveying expedition, Dec. 5, 1872. Detached May 13, 1873, and three months leave. Naval Academy Oct. 6, Department English and Law; detached July 30, 1874. Sept. 4 to the Plymouth, but order revoked Sept. 10. Nov. 23 special duty on isthmus Darien, leaving New York in steamer of Jan. 2, 1875. Detached May 31, and to special duty at Washington connected with the survey. Feb.

11, 1876, detached, and to the Monongahela, Home station; July 5 detached. Hydrographic Office, Aug. 1—Sept. 19, when to command of the Coast Survey schooner Palinurus. Feb. 29, 1880, to training-ship Saratoga. June 29, 1881, as member of Naval Advisory Board. Died, Washington, D. C., Oct. 27, 1881. Total sea service, nine years, seven months; shore duty, seven years, two months; in service, eighteen years, three months.

Mr. Ebenezer Pearson Dorr. Born in Hartford, Vermont, March 13, 1817. His earliest inclinations were for a seafaring life, and when only ten years of age he sailed from Newburyport as a boy before the mast. When hardly more than a boy he became an officer, and not long after, the commander of a ship. In 1838 he settled in Buffalo, and commanded different vessels engaged in lake navigation. In 1843 he gave up marine for insurance interests, becoming marine inspector of the Buffalo Mutual Insurance Company, and, later, agent for the New York Board of Underwriters, and for several prominent marine insurance companies. He held at different times the position of President of the Board of Inland Underwriters, President of the Buffalo Board of Trade, and a Vice-President of the National Board of Trade. Mr. Dorr was very active in obtaining more liberal regulations for wrecking in Canadian waters, and in securing the removal of the rocks in Detroit river. He may also be regarded as a pioneer in the meteorological work now performed by the Signal Service, as, at the request of Lieutenant Maury, he, for a long time, forwarded daily reports of the wind and weather at Buffalo. Mr. Dorr was well acquainted with many prominent naval officers, and was elected an Associate Member of the Naval Institute in 1879, and a member in 1880. He died in Aiken, S. C., March 29, 1881.

Lieutenant Henry Christie Hunter. Born in Brooklyn, N. Y., 1847. Appointed Midshipman from New York. Entered Naval Academy, Sept. 22, 1863. Graduated June 6, 1867, No. 20 in a class of 87 members. June 10 to the Minnesota. Transferred to the Guard, European station, Sept. 15, and later to the Canandaigua. Oct. 15, 1868, transferred to the Ticonderoga. Promoted to Ensign, Dec. 18. Detached April 28, 1869. New York Yard June 11—Aug. 9, when to the Severn, Home station. Promoted to Master, March 21, 1870. Transferred to the

Congress. Promoted to Lieutenant, Feb. 19, 1872, with rank from March 21, 1871. Detached March 18, 1874, and to the Receiving ship Colorado. June 4 detached. Sept. 4 to ordnance duty, Washington Yard. April 17, 1875, to the Tennessee, Asiatic station. Dec. 18, 1875, invalided. Receiving ship Colorado Feb. 2—April 12, 1877; Supply, store-ship European station, as Executive, April 21—Sept. 14. Dec. 11 to the Tuscarora, but order revoked, and December 17 to the Receiving ship Independence. Mare Island Yard, May 20, 1878—February 25, 1879, when to the Alert, Asiatic station. Died on board, off Vries Island, June 10, 1881. Total sea service, ten years, three months; shore duty, five years, three months; in service, seventeen years, nine months.

Superintendent of the U. S. Coast Survey, Carlile Pollock Patterson. Born, Shieldsboro, Miss., Aug. 24, 1816. Appointed Midshipman, Sept. 2, 1830, from the District of Columbia. Sept. 14 to the Brandywine, Mediterranean squadron. Warranted as Midshipman, Nov. 1, 1831, with date from Sept. 2, 1830. Transferred to the Delaware, 1835. Warranted Passed Midshipman, June 15, 1836, with rank from June 4, 1836, No. 4. July 21, 1836, to the Washington Yard; Dec. 31 detached and leave of absence. March 26, 1838, to Coast Survey duty. Sept. 21, 1841, commissioned Lieutenant, with rank from Sept. 8, 1841. Detached April 1, 1842. April 5, to the Boxer, Home squadron; detached Jan. 9, 1844, and leave of absence. March 12 to Coast Survey duty, commanded schooner Phenix and steamer Walker; Nov. 22, 1849, detached. April 4, 1851, granted furlough for one year with permission to leave the United States. March 16, 1852, furlough extended one year from April 4. March 2, 1853, furlough extended six months. Sept. 12, 1853, resignation accepted. Appointed Hydrographic Inspector U. S. Coast Survey in 1861, and Superintendent of the Coast Survey in 1874. Elected an Honorary Member of the Naval Institute in 1879. Died, Washington, D. C., Aug. 15, 1881.

Chief Engineer James Paddock Sprague. Born, Wyoming, N. Y., Feb. 16, 1837. Appointed Third Assistant Engineer, Feb. 17, 1860. August 25, to the Richmond, Mediterranean squadron. July 27, 1861, detached and to special duty at New York. Promoted to Second Assistant Engineer, Nov. 1, 1861. June 17, 1862, sick leave. August 23, 1862, to the Ottawa, S. Atlantic Blockading

squadron; detached Oct. 2, 1864. Promoted to First Assistant Engineer, March 1, 1864. Galena, Home station, Jan. 25—June 13, 1865. Special duty connected with the Algonquin, at New York, July 28, 1865—March 10, 1866. Wateree, South Pacific station, June 1, 1866—Sept. 30, 1868. Boston Yard, Nov. 19, 1868—Sept. 26, 1870, when ordered to the Congress, Home station. Transferred to the Dictator; detached June 23, 1871. Promoted to Chief Engineer, March 5, 1871. Iroquois, Asiatic station, March 6, 1872—July 24, 1874. In charge stores, Washington Yard, Oct. 29, 1874—Oct. 22, 1877. Experimental duty to June 25, 1878. To the Naval Academy as Head Department Steam Engineering, June 26, 1878. Died at Rochester, N. Y., Sept. 15, 1881. Total sea service, nine years, seven months; shore duty, nine years, five months; in service, twenty one years, seven months.

LIEUTENANT COMMANDER ARTHUR H. WRIGHT. Born in Ohio, Sept., 1845. Appointed Midshipman, Sept. 28, 1860, from Ohio, and entered Naval Academy. Sept. 30, 1863, detached, and Oct. 1, promoted to Acting Ensign. Dec. 12, to the Ticonderoga, detached Dec. 31, and to the Richmond, W. Gulf Blockading squadron. In battle, Mobile bay, August 5, 1864. Transferred to the Milwaukee, and when that vessel was sunk by torpedo, March 28, 1865, in Blakely river, he went to the Osage, which was destroyed in the same manner the next day. Transferred to the Cincinnati, S. Atlantic Blockading squadron. Aug. 16, 1865, to the Ticonderoga, European squadron. Commissioned Master, May 10, 1866; Lieutenant, Feb. 21, 1867; Lieutenant Commander, March 12, 1868. Detached Nov. 12, 1868. July 26, 1869, to the Rec'g Ship, N. Y. Yard; detached Aug. 9, and to the N. Y. Yard. Detached Sept. 12, and to the Naval Academy as instructor in the Deptmt. English. Aug. 11, 1870, detached. Sept. 28, to the Narragansett, Pacific station, as Executive. Detached April 25, 1873, and invalided. July 24, to the Michigan, on the Lakes, as Executive; detached April 27, 1874, and to the Swatara, transit of Venus expedition, as Executive. July 1, 1875, detached. Feb. 21, 1876, to the Michigan, as Executive; in command May 20, 1876 to July 26, 1877. Detached Jan. 31, 1879. Torpedo instruction, Newport, R. I., June 2 to Sept. 6th. Oct. 17, six months leave. June 4, 1880, Light House Inspector, 7th District. Died at Key West, Fla., of yellow fever, Nov. 5, 1881. Total sea service, twelve years, eight

months; shore duty, five years, three months; in service, twenty-one years, one month.

Lieutenant Thomas Coke Terrell. Born, Connersville, Ind., 1847. Appointed Midshipman from Indiana; entered Naval Academy, Sept. 20, 1862; graduated No. 34 in a class of 74 members, June 12, 1866. Gettysburg, Home station, Nov. 20, 1866—Feb. 27, 1867. April 19, to the Guerriere, S. Atlantic station. Promoted to Ensign, March 12, 1868. Transferred to Quinnebaug, to Wasp, and again to Quinnebaug. Promoted to Master, March 26, 1869. Detached July 18, 1870, and to examination. Promoted to Lieutenant, with rank from March 21, 1870. Torpedo station, Oct. 17th—April 25, 1871. Michigan, on the lakes, May 15, 1871—June 4, 1872, when detached, and to the California, Pacific fleet. Transferred to the Saranac. Detached May 23, 1874, and on sick leave. Rec'g ship New Hampshire, June 25—Jan. 5, 1875, when detached, and to the Brooklyn, S. Atlantic station. Detached June 19, 1876, and to the Wyandotte, N. Atlantic station. July 3, to command Wyandotte. July 24, 1877, to command Passaic; detached July 26. Oct. 31, to Hydrographic Office. May 16, 1879, detached, and to Wachusett, order revoked and waiting orders. Nov. 10, to the training ship Constitution. Nov. 29, 1879, detached and on sick leave. Pensacola Yard, Feb. 1, 1881. Died, Pensacola, Fla., May 16, 1881. Total sea service, nine years, eight months; shore duty, five years, nine months; in service, eighteen years, eight months.

ANNUAL REPORT OF THE SECRETARY.

MR. PRESIDENT, AND MEMBERS OF THE INSTITUTE.

I have the honor to make the following Report in regard to matters connected with the Naval Institute for the preceding year, speaking at the same time for the Executive Committee, as well as for myself, as Secretary.

The total membership of the Institute, as compared with that at the same time last year, is as follows:

	Members.	Life Members.	Honorary Members.	Associate Members.	Total.
Jan. 1881,	454	2	6	19	481
Jan. 1882,	474	4	6	22	506
Increase,	20	2	0	3	25

From this it will be seen that the increase in total membership is twenty-five. Eighty-one new members joined; two became life members (the authors of the Prize Essays of 1880 and 1881); eight members and an honorary member died; twenty-three members resigned, and twenty-eight were dropped from the rolls; one honorary and three associate members were elected. I have not counted among the members, as may be seen, the twenty-eight whose names have been dropped from the rolls, as directed in Section 8, Art. IV, of the Constitution. Many of these members are serving on foreign stations where it is difficult to obtain drafts for small amounts of money, and the Executive Committee has, therefore, exercised its discretion in retaining upon the roll of members those who have signified an intention to pay their dues upon return home, but no copies of the Proceedings are sent to any one who is one year in arrears. In this connection I may add that it would prevent the loss of copies of the Proceedings, not easily replaced, and greatly lessen the labor of the Secretary, if members would notify him of a change in address. During the two years that I have been Secretary, while the addresses of

the great majority of the members have been changed, many of them twice, I have received barely a score of notifications to that effect!

In the competition for the prize of 1881, upon the subject, *The Type of (1) Cruiser (2) Armored Vessel best suited to the Present Needs of the United States*, two of the judges—Commodore W. N. Jeffers and Chief Constructor John Lenthall—concurred in preferring the essay written by Lieut. E. W. Very, while the other judge—Chief Engineer J. W. King—designated that written by Lieut. S. Schroeder as most worthy. In accordance with the decision of the majority, the prize was awarded to the former. Both essays, with the decisions of the judges, have been printed in the Proceedings.

The subject selected for the Prize Essays of 1882 was, *Our Merchant Marine: the Causes of its Decline, and the Means to be taken for its Revival.* The increase in the interest taken in this competition is, perhaps, in no way more clearly shown than by the increase in the number of competitors. In 1880 there were eight; in 1881, four; and this year there are eleven. These essays have been sent to the judges chosen—Hon. Hamilton Fish, ex-Secretary of State, Mr. John D. Jones, President of the Atlantic Mutual Insurance Company, and Mr. A. A. Low, formerly President of the New York Chamber of Commerce.

During the year four numbers of the Proceedings have been published, comprising No. 14, the last number of Vol. VI, and Nos. 15, 16 and 17, or three parts of Vol. VII; material for No. 18, the last part of Vol. VII, is in hand and will shortly be sent to the printer. As papers are frequently presented of too technical a character, and involving too close an attention to details to be followed when read before an audience, it may become necessary to depart in a measure from the present custom, and to insert papers in the Proceedings which have been read by title only. It has been found impossible to reproduce the discussions upon papers, in exactly the form which they took, as there is no stenographer in Annapolis, and as the Executive Committee has not felt justified in having a reporter from Baltimore or Washington in attendance at the meetings.

The Institute lost the unusually large number of nine of its members by death during the year. Among them was the Treasurer, Chief Engineer James P. Sprague, who died on the 15th of September. He was elected Treasurer in 1879, again in 1880 and in 1881. He had thus served continuously for over two years and a half, and the Institute is greatly indebted to him for valuable and faithful services ren-

dered by him cheerfully in spite of failing health. A record of his and of the other deceased members' naval services will be published in a forthcoming number.

The number of exchanges has been increased, and the Proceedings are now sent to all the prominent foreign and domestic professional periodicals, and to many scientific societies at home and abroad. I take great pleasure in announcing that the Hon. Secretary of the Navy has subscribed to fifty copies of each issue,* one-half of which he permits to be sent to exchanges. Numbers of copies of separate articles have been sold, notably the paper by Lieut. Commander Chadwick, entitled "Aids to Navigation," of which the Light-House Board took five hundred copies. This, and the fact that a number of subscriptions from non-members has been received, are gratifying evidences that the interest in the Proceedings is not confined exclusively to the members of the Institute.

In conclusion I would say that it has been the constant aim of the Executive Committee to extend the influence and to advance the interests of the Institute to the best of their ability, and they desire, through me, to return thanks to the many who, by their hearty co-operation and invaluable participation, have aided them in their endeavors.

Respectfully,

CHARLES BELKNAP,

Lieutenant, and Secretary.

ANNAPOLIS, MD., *Jan. 12, 1882.*

U. S. NAVAL INSTITUTE,

Annapolis, Md., Oct. 17, 1881.

REAR ADMIRAL C. P. R. RODGERS, U. S. N.,

Superintendent Naval Academy.

SIR:

I have the honor to submit to your approval the following plan for the benefit of the Naval Institute, and ask if, in your opinion, favorable action by the Navy Department may be hoped for.

Contrary to the practice of the principal European governments, our Navy Department maintains no professional journal for the advancement of naval officers and for the publication of general orders and other official matter. France has the *Révue Maritime;* Italy, the *Rivista Marittima;* Austria, the *Mittheilungen a. d. Gebiete d. Seewesens;* Spain, the *Revista General de la Marina:* in each case the journal is printed under government direction. England allows the Royal United Service Institution £600, or $3000, yearly to aid in the publication of its Journal.

* See letters appended.

The *Proceedings of the U. S. Naval Institute* are sent to the above and also to many other professional journals, and to many scientific societies at home as well as abroad, and by them regarded as a government publication, or, at least, as published with government aid. The annual prize, given by the Institute, for the best essay is also looked upon abroad as an act of the government. I need not point out to you the fallacy of this view—that really the *Proceedings of the Institute* depend for their issue upon the uncertain amounts collected from an ever varying number of members. In order that they may in a measure become official and, at the same time, have their existence based upon a solid foundation, the Navy Department might subscribe for one hundred copies of each issue of the *Proceedings*, amounting to $300 yearly; these numbers would be sent to the above-mentioned exchanges, to libraries, and to the government offices in Washington, as might be directed by the Navy Department. In return, a portion of each number would be devoted to the publication of transfers of officers, movements of vessels, general orders, etc.; matter communicated officially by the Hon. Secretary of the Navy to the service.

Trusting that this plan, which would tend to aid the end for which the Institute was organized—the advancement of professional and scientific knowledge in the Navy—will meet with your approval,

I am, sir, very respectfully, your obedient servant,

CHARLES BELKNAP,
Lieut. and Secretary.

[Copy.]

Navy Department,
Washington, Dec. 1, 1881.

Sir:

Your letter of the 19th ultimo, enclosing a communication from Lieutenant Charles Belknap, in relation to the U. S. Naval Institute, has been received.

The Department will subscribe for fifty copies of the *Proceedings of the Institute*, at the rate of three dollars per annum, per copy, to be paid for by quarterly-approved bills, at the end of each quarter, or annually, at the end of the year.

Very respectfully,
(Signed) WILLIAM H. HUNT,
Secretary of the Navy.

Captain F. M. Ramsay, U. S. N.,
Superintendent Naval Academy.

Received Dec. 2, 1881, and this copy forwarded for the information of Lieut. Chas. Belknap, Secretary Naval Institute.

F. M. RAMSAY,
Captain and Superintendent.

TREASURER'S REPORT.

To the President, Officers and Members
of the U. S. Naval Institute.

Gentlemen:—

Chief Engineer James P. Sprague, who was, for many years, the faithful Treasurer of the Institute, died on the 15th Sept., 1881. Lieut. Charles Belknap, who was then Secretary, settled his accounts, and acted as Treasurer till my election on the 24th Oct., 1881.

The Treasurer's statement for the whole year of 1881 must therefore be constructed of the fractional accounts of Mr. Sprague, Mr. Belknap and myself; and to the best of my ability I have united them from the 7th Jan., 1881 (the date of Mr. Sprague's last report), to Jan. 1st, 1882, and the result is as follows:

Receipts.

Amount on hand per Mr. Sprague's last report, . . .		$ 601.04
Received as dues, ...		1,265.02
Received from sale of Proceedings, ...		50.45
Received for advertising, ...		30.00
Total receipts, ...		$1,946.51

Expenditures.

For incidental expenditures of Branches, .	$101.58	
For incidental expenses at Annapolis, ...	93.84	
For printing and engraving, ...	719.59	
For prize essays, ...	300.00	
For purchase of back numbers of Proceedings .	8.35	$1,223.36
Balance on hand, Jan. 1st, 1882, . .		$723.15

As the issue of this number (which is the first for 1882) has been so long delayed, and as I prefer to give members the latest possible information as to the financial condition of the Institute, and prefer also to limit my own responsibility as Treasurer, I now submit my account from the day I became Treasurer (Oct. 24th, 1881) to date (May 10th, 1881).

RECEIPTS.

Oct. 24th, 1881, received from Lieut. C. Belknap as cash deposited in bank, and in hand, ...	$ 311.08
Received in dues since Oct. 24, 1881, ...	1,332.25
Received from advertising, ...	40.00
Received from sale of Proceedings, ...	429.87
Received from interest on U. S. Bonds, ...	4.00
	$2,117.20

EXPENDITURES.

For postage, freight and expressage at Annapolis,	$ 61.26	
For stationery and account books, ...	114.36	
For printing and engraving, ...	314.37	
For prize essay, ...	150.00	
For purchase of back numbers Proceedings, .	25.10	
For expenses of Branches, ...	16.00	
For purchase of $400 in U. S. 4 per cent. bonds,	$473.52	
Total expenditures, ...		$1,154.61
Balance of cash on hand, May 10th, 1882,		$ 962.59

A few months ago, having a large surplus of the funds of the Institute in hand for which there was no immediate use, I purchased, with the approval of the other members of the Executive Committee, $400 worth of 4 per cent. Government bonds, for which I paid $473.52, as entered on the foregoing account. Since then I have received and credited to the Institute $4 as interest on these bonds, and the bonds themselves are now worth two per cent. more than was paid for them. Their present market value, which is $487, should be added to the balance of $962.59 cash on hand, as stated above, making $1449.59. To this should be added the cash on hand at the various Branches, which at last report was $67.66, making $1517.25; and to this amount should also be added as convertible into cash, certain stamped and large envelopes, which are in excess of the necessities of the Institute for the present year, and which could immediately be sold or redeemed for $69.60, which increases the cash assets to $1586.85.

The Institute has now on hand 1473 of back numbers, which, by the constitution, the Treasurer is required to report among the assets. It would be difficult to assign to them any correct definite value, but we are selling them at $1 per number, less 10 per cent. to members and book-dealers; and the demand for them is increasing. They acquire a certain reflex value, from the later numbers, and as the current publications of the Institute increase in apppreciation they will be more in demand. In addition to the irregular sales of separate numbers, there have been sold during the past year at least ten complete sets at the price named above.

It can properly be said here that one of the most encouraging and conclusive evidences of the prosperity of the Institute is the increasing demand for its publications, from sources outside of the Navy. The Proceedings of the Institute have earned a modest, but permanent, commercial standing in the scientific literature of the day.

Against this balance of $1586.85, which has been stated above as the determinable cash assets, should be charged the bill for printing No. 18, which has not yet been rendered, but deducting the orders we have received from book-dealers, it will not cost the Institute, including all the reprints, over $250; probably much less than that.

There is due the Institute from members in arrears $81 for 1880, $222 for 1881, and $994.38 for 1882. No special effort has been made to collect the dues for 1882, but they have come in, either directly or through corresponding secretaries, by an easy law of the pecuniary gravitation of membership. Except in the case of some of those who owe for 1880, the Institute will get all these arrearages.

Of the $429.87 above noted as received from sale of Proceedings, $160 came from John D. Jones, Esq., of New York City. Mr. Jones was one of the judges who decided upon the merits of the competitive essays for the last annual prize, and became so much interested in them and the work and purposes of the Institute, that he paid this money on the easy condition that the Institute should publish certain of these essays which he named. His contribution was largely in excess of what was needed for the purpose, even if the Institute had thought best to publish these essays solely for him. But the essays had such intrinsic merit, and had been so favorably mentioned by the Prize Committee, that the Institute has published them in its own interest, and they appear in this number. This makes, therefore, Mr. Jones's contribution of $160 virtually a gratuity, and, as such, it is hereby gratefully acknowledged. The Institute did not seek it, and does not need such favors from any one; but when they come, unsought, from such an appreciative source, and under such honorable conditions, the Institute can be both grateful and proud.

The policy of the officers of the Institute is to redress, as far as possible, all old grievances and to create no new ones; to give prompt acknowledgment and keep a correct record; to deal equitably with the rights of those they represent and by whom they were elected; and to so identify their labors, and the labors of their contributors, with the growth and necessities of the naval service, that the Navy and the Institute shall live and last together.

ROBERT W. ALLEN,

Paymaster U. S. Navy, and Treasurer U. S. Naval Institute.

CONSTITUTION.

Title.

Article I. The organization shall be known as the United States Naval Institute.

Object.

Art. II. Its object shall be the advancement of professional and scientific knowledge in the Navy.

Organization and Officers.

Art. III. Sec. 1. The officers and permanent committees of the Society shall include:

A President.
A Vice-President.
A Secretary.
A Corresponding Secretary. } Executive Committee.
A Treasurer.
A Committee on Publication.
Vice-Presidents and Corresponding Secretaries of Branches.

Sec. 2. Special Committees may at any time be appointed, by a majority vote of the Society, to consider questions not properly under the cognizance of the Standing Committees.

Membership.

Art. IV. Sec. 1. The Institute shall consist of members, life members, honorary members, and associates.

Sec. 2. All officers of the Navy, Marine Corps, and all civil officers attached to the Naval service shall be entitled to become members, without ballot, on payment of dues to the Treasurer, or to the Corresponding Secretary on the station. Other persons may become members, on election by ballot, under the rules governing the election

of honorary and associate members (see Art. IV, Sec. 6), and on payment of dues; provided that the number of members not officially connected with the Navy shall not at any time exceed (50) fifty.

SEC. 3. All those who are entitled to become members, may become life members, on payment of thirty dollars. As a reward for extraordinary services to the Institute, or as a mark of honor, the Institute may create life members without payment of dues. Nominations for life members must be made by the Executive Committee, and a majority vote of members shall be required to elect the candidate. The Prize Essayist of each year shall be a life member without payment of dues.

SEC. 4. Honorary members shall be selected from distinguished Naval and Military officers, and from eminent men of learning in civil life; provided that the number of such members shall in no case exceed thirty. The Secretary of the Navy shall be, *ex-officio*, an honorary member.

SEC. 5. Associates shall be chosen from persons connected with the Naval and Military professions, and from persons in civil life who may be interested in the objects that it is the design of the Institute to advance.

SEC. 6. Honorary members and associates shall be elected as follows: nominations shall be made in writing to the Executive Committee, and such nominations, with the name of the member making them, shall be entered on the minutes of the Committee. At the succeeding meeting of the Institute the Committee shall report. If their report be favorable, a majority of the members present shall decide the election; but if unfavorable, a two-thirds vote shall be required to elect the candidate. Two members of the Executive Committee shall constitute a quorum for carrying out the requirements of this section.

SEC. 7. The annual dues for members and associate members shall be three dollars, payable upon joining the Institute, and upon the first day of each succeeding January.

SEC. 8. Membership shall be forfeited in cases when the recommendation of the Executive Committee, supported by a two-thirds vote of the Society, shall so determine, and members two years in arrears shall be dropped. Those who have been dropped from the list of members for being two years in arrears can only regain their membership by paying up their arrears.

Nominations and Elections.

Art. V. Sec. 1. There shall be a meeting of the Society on the second Thursday in January of each year, at which all officers shall be chosen, except as provided in Art. VIII, Secs. 6 and 7.

Sec. 2. Members not in attendance may vote by proxy at such elections as well as upon questions relating to the Constitution and By-Laws, but vote by proxy will only be allowed in the two cases herein specified. Life members have full rights with members to vote on any question. Honorary members and associates will not be allowed to vote on any question.

Sec. 3. A majority of votes recorded shall determine choice.

Sec. 4. Members elected to the position of officers of the Society will assume their duties as soon as notified.

Sec. 5. Vacancies may be temporarily filled by the Executive Committee, but regular nominations and elections shall follow as soon as practicable.

Sec. 6. All voting for officers shall be by ballot, in session of the Society.

Duties of Officers.

Art. VI. Sec. 1. The President, or, in his absence, the Vice-President, or in the absence of both, a member of the Executive Committee, will preside in executive session.

Sec. 2. The transaction of all financial, executive or administrative business, in which latter shall be included censorship of papers offered for presentation to the Society, shall be in the hands of the Executive Committee. The Committee will determine for itself its routine of business and form of record.

Sec. 3. The Secretary shall keep a register of the members, a copy of the Constitution and By-Laws in which he shall note all changes, a journal of the proceedings of the Society, a separate record of the proceedings of the Executive Committee, and a file-book in which the reports of committees shall be entered. These books shall be at all times in readiness for inspection. Papers offered by members unable to be present, if accepted by the Executive Committee, shall be read by the Secretary. He shall give due notice of all meetings of the Society, and shall have control of the stenographer and copyists employed to prepare records of the proceedings.

Sec. 4. The Corresponding Secretary shall attend to all correspondence, and keep a record thereof.

Sec. 5. The Treasurer, under the direction of the Executive Committee, shall be the disbursing officer. He shall keep a receipt and expenditure book, and an account current with each member. He will submit his books for examination whenever asked for.

Sec. 6. The Committee on Publication shall have charge of the printing and publication of all papers and proceedings of the Society.

Meetings.

Art. VII. Sec. 1. There shall be a meeting of the Society on the second Thursday of each month, for the discussion of professional and scientific subjects.

Sec. 2. Special meetings may be called by the Secretary at the request of one or more of the general officers, or of standing or special committees.

Sec. 3. A stenographer shall be employed to keep the record of all proceedings of regular meetings.

Sec. 4. Annually, or as much oftener as the Executive Committee may decide, a record of papers read before the Society and the discussions growing out of them shall be published in pamphlet form. Papers on intricate technical subjects may be published as a part of the proceedings of the Society without being publicly read, if, in the opinion of the Executive Committee, the subject to which they relate be not of a character to be appreciated on merely casual investigation.

Branches.

Art. VIII. Sec. 1. The Executive Committee is empowered to appoint temporary Corresponding Secretaries for all Naval Stations, both ashore and afloat, where there is no organized Branch; also for Branches where a vacancy exists owing to the resignation of the Corresponding Secretary before a meeting can be called to elect a successor.

Sec. 2. The officers shall be a Vice-President, Corresponding Secretary, and an Executive Committee, composed of the Vice-President and Secretary, *ex-officio*, and one other member.

Sec. 3. The Vice-President of the Branch shall perform the same duty for the Branch as prescribed for the President of the Institute.

Sec. 4. The Corresponding Secretary of a Branch shall keep a register of the members, honorary members and associate members of the Institute residing within the limits of the station, a copy of the

Constitution and By-Laws in which he shall note all changes, and a journal of the proceedings of the Branch. He shall give due notice of all meetings of the Branch, and shall have control of the stenographer and copyist employed to prepare the records of the proceedings. He shall forward to the Corresponding Secretary of the Institute all papers read before his Branch, and shall keep him informed of all new members and their addresses, and of all business, not financial, relating to the Institute. He shall have charge of the library, and of all books and papers, and shall receive and distribute publications. He shall keep a receipt and expenditure book, shall collect dues from all the members on his station, and give receipts therefor. He shall be authorized to expend the funds in his possession for stationery, postage and printing, and for such other expenses as the Executive Committee of his Branch may authorize. He shall, at the end of every month, render to the Treasurer a detailed statement of moneys received, with the names of members from whom received, and shall, at the end of every month, forward to the Treasurer all funds remaining in his hands and vouchers for money expended, retaining sufficient money to defray the current expenses of the Branch.

SEC. 5. Those members of the Institute residing within the limits of a station where a Branch is established shall be enrolled on the books of the Corresponding Secretary of that Branch during the time of their residence on the station; they will pay him their dues, keep him informed of their addresses, and receive from him their copies of the publications.

SEC. 6. Monthly meetings of each Branch shall be held, upon such dates as the Branch shall decide, and other meetings at the call of its Executive Committee. It shall be the duty of the Executive Committee of the Branch to call an annual meeting for the election of officers of the Institute, at a sufficient time prior to the regular meeting of the Institute at Annapolis for the election of officers to enable the Corresponding Secretary to forward the votes to the Corresponding Secretary of the Institute. Votes not received at the regular annual meeting of the Institute shall be invalid.

SEC. 7. The officers of a Branch shall be elected for one year, at the first annual meeting of the Branch. All voting for officers shall be by ballot, in executive session. In the event of the appointment of a Temporary Corresponding Secretary and his acceptance of the appointment; it shall be his duty to call a meeting of all members

within the limits of his station at least one month after his appointment, to organize the Branch, by the election of officers, who shall hold office until the regular annual election.

SEC. 8. All papers offered must be submitted for examination to the Executive Committee of the Branch, and if by them accepted they may be read before the Branch and published in the Proceedings. But the Executive Committee of the Institute has a final censorship of all papers before they are published. Papers should be read by authors, or, in their absence, by the Corresponding Secretary, unless the author designates a particular person whom he wishes to read the paper.

PAPERS AND PROCEEDINGS.

ART. IX. SEC 1. The papers and proceedings of the Institute shall constitute assets, and be so borne on the books of the Treasurer and accounted for.

SEC. 2. One copy of the Proceedings, when published, shall be furnished to each member, life member, honorary member, and associate member, the Library of the Naval Academy, Corresponding Societies, Congressional Library, Boston Public Library, Library of Harvard University, and Naval Library at Mare Island.

SEC. 3. Back numbers of Proceedings shall be furnished to members at a charge which shall be fixed by the Executive Committee. The Proceedings may be furnished to non-members at a cost ten per cent. higher than that at which they are furnished to members.

SEC. 4. No copies shall be furnished to members who are one year in arrear.

AMENDMENTS.

ART. X. No addition nor amendment to the Constitution and By-Laws shall be made without the assent of two-thirds of the members voting. Notice of proposed changes or additions shall be given by the Secretary, at least one month before action is taken upon them.

BY-LAWS.

ARTICLE I. The rules of the United States House of Representatives shall, in so far as applicable, govern the parliamentary proceedings of the Society.

ART. II. 1. At both regular and stated meetings the routine of business shall be as follows:

2. At executive meetings, the President, or in his absence the Vice-President, or, in the absence of both, a member of the Executive Committee, will call the meeting to order, and occupy the chair during the session; in the absence of these, the Society will appoint a chairman.

3. At meetings for the presentation of papers and discussion, the Society will be called to order as above provided, and a chairman will be appointed by the presiding officer, reference being had to the subject about to be discussed, and an expert in the specialty to which it relates selected.

4. At regular meetings, after the presentation of the paper of the evening, or on the termination of the arguments made by members appointed to, or voluntarily appearing to enter into formal discussion, the chairman will make such review of the paper as he may deem proper. Informal discussion will then be in order, each speaker being allowed not exceeding ten minutes in the aggregate, unless by special agreement of the Society. The author of the paper will, in conclusion, be allowed such time in making a résumé of the discussion as he may deem necessary. The discussion ended, the Chairman will close the proceedings with such remarks as he may be pleased to offer.

5. At the close of the concluding remarks of the Chairman, the Society will go into executive session, as hereinbefore provided, for the transaction of business, as follows:

1. Stated business, if there shall be any to be considered.
2. Unfinished business taken up.
3. Reports of Officers or Committees.
4. Applications for membership reported.
5. Correspondence read.
6. Miscellaneous business transacted.
7. New business introduced.
8. Adjournment.

PROCEEDINGS

OF THE

UNITED STATES NAVAL INSTITUTE.

Organized October 9th, 1873, at the U. S. Naval Academy.

CONTENTS.—VOLUME I TO VII INCLUSIVE.

VOLUME I, No. 1. WHOLE No. 1. 1874.

VOLUME II, No. 1. Whole No. 2. 1876.

VOLUME III, No. 1. Whole No. 3. 1877.

VOLUME IV, No. 1. Whole No. 4. 1878.

VOLUME IV, No. 2. Whole No. 5. 1878.

VOLUME V, No. 1. Whole No. 6. 1878.

VOLUME V, No. 2. Whole No. 7. 1879.

VOLUME V, No. 3. Whole No. 8. 1879.

VOLUME V, No. 3—(Continued.)

VOLUME V, No. 4. WHOLE No. 9. 1879.

VOLUME V, No. 5. WHOLE No. 10. 1879.

VOLUME VI, No. 1. WHOLE No. 11. 1880.

VOLUME VI, No. 1—(Continued.)

VOLUME VI, No. 2. WHOLE No. 12. 1880.

VOLUME VI, No. 3. WHOLE No. 13. 1880.

VOLUME VI, No. 4. WHOLE No. 14. 1880.

VOLUME VII, No. 1. Whole No. 15. 1881.

VOLUME VII, No. 2. Whole No. 16. 1881.

VOLUME VII, No. 3. Whole No. 17. 1881.

VOLUME VII, No. 3—(Continued.)

VOLUME VII, No. 4. Whole No. 18. 1881.

NAVAL INSTITUTE PRIZE ESSAY, 1883.

A Prize of one hundred dollars and a gold medal of the value of fifty dollars, is offered by the Naval Institute for the best Essay presented, subject to the following rules:

1. Competition for the Prize is open to all members, and to all persons entitled to become members upon payment of dues; that is, to all officers of the Navy and Marine Corps, and to all civil officers attached to the Naval service. But members who have been dropped for non-payment of dues are not eligible for membership until their arrears of dues have been made good.

2. Each competitor to send his essay in a sealed envelope to the Secretary on or before January 1, 1883. The name of the writer shall not be given in this envelope, but instead thereof a motto. Accompanying the essay a separate sealed envelope will be sent to the Secretary, with the motto on the outside and writer's name and motto inside. This envelope is not to be opened until after the decision of the Judges.

3. The Judges to be three gentlemen of eminent professional attainments, to be selected by the Executive Committee, who will be requested to designate the essay, if any, worthy of the Prize, and, also, those deserving honorable mention, in the order of their merit.

4. The successful essay to be published in the Proceedings of the Institute, and the essays of other competitors, receiving honorable mention, to be published also, at the discretion of the Executive Committee.

5. Any essay not having received honorable mention, to be published only with the consent of the author.

6. The subject for the Prize Essay is, "*How may the Sphere of Usefulness of Naval Officers be Extended in Time of Peace with Advantage to the Country and the Naval Service?*"

7. The Essay is limited to forty-eight printed pages of the "Proceedings of the Institute."

8. The money value of the medal may be given to the successful competitor, if he so elect, and he will be made a Life Member of the Institute.

CHAS. M. THOMAS,
Secretary.

ANNAPOLIS, MD., *March* 9, 1882.

PRIZE AND OTHER ESSAYS.

1882.

New York, February 11, 1882.

Lieut. Charles Belknap, U. S. N.,

Secretary U. S. Naval Institute, Annapolis, Md.

Sir:

The undersigned having been requested to serve as Judges to determine to whom shall be awarded the gold medal and prize offered by the Naval Institute for the best essay on the subject "Our Merchant Marine: the causes of its decline, and the means to be taken for its revival," have examined eleven essays submitted in competition. Many of them have much merit; but on a subject of the broad historical and practical nature of that submitted for competition, it will not be understood that in indicating any of them, the undersigned adopt as their own the entirety of the views therein presented, or the completeness of their conclusions either as to the causes of decline or the means for revival. They are prepared, however, to designate the essay under the motto "*Nil clarius aquis*" as combining the most merit, and as worthy of the prize.

In accordance with the request that if there be another essay, or others, worthy of honorable mention, it be designated, or if more than one, they be mentioned in the order of merit, the undersigned designate the essay bearing the motto "*Mais il faut cultiver notre jardin*" as second in the order of merit, and they further mention those bearing the respective mottoes "*Causa latet, vis est notissima*" and "*Spero meliora*" as worthy of honorable mention, without, however, being entirely agreed as to their comparative merits.

We are, sir, very respectfully yours,

HAMILTON FISH,
A. A. LOW,
J. D. JONES.

THE PROCEEDINGS

OF THE

UNITED STATES NAVAL INSTITUTE.

Vol. VIII. No. 1. 1882. Whole No. 19.

NAVAL INSTITUTE, ANNAPOLIS, MD.

MARCH 9TH, 1882.

COMMANDER H. B. ROBESON in the Chair.

OUR MERCHANT MARINE: THE CAUSES OF ITS DECLINE, AND THE MEANS TO BE TAKEN FOR ITS REVIVAL.

By LIEUT. J. D. J. KELLEY, U. S. N.

"*Nil clarius aquis.*"

I.

It is a curious fact that a great commercial question, vital in its influence upon the wellbeing of an eminently practical nation, should so often be approached upon the side of sentiment. A bewildering maze of statistics, an array of accommodating figures, and a dexterous spinning of subtle phrases, are made to form the premises, not of an irrefutable conclusion, but of an appeal, which fires the heart, if it do not satisfy the head, of many a patriot. To discuss a question so sober, so melancholy as the restoration of the Merchant Marine, from the standpoint of its poetical merits, is not *a priori* convincing of its imminent necessity; and, whether an advocate shines in the broad light-beam of free trade, or is glorious in the panoply of

protection, he should forswear heroics and pleas *ad hominem*, and treat the subject from the grossly material vantage-ground of dollars and cents. There should be in the beginning, for example, a thorough understanding of the terms to be employed in the discussion : a spade should be called a spade, and mean nothing else ; the necessity and fitness for the possession of a merchant marine by any country should be proven, and not assumed ; the history and growth of the industry should be studied and compared ; the causes of its decay should be formulated ; and then, as with an invalid after a careful diagnosis by a physician, the remedies should be prescribed. Sentiment can no more enter this problem than into the determination of the next eclipse ; and so far as the question permits, all its complex and interdependent conditions should be viewed and tested.

It is an axiom that the greatest good to the greatest number is secured, where trade and industrial questions are operative, when the whole population of a nation is engaged in those pursuits which pay best under the environment of the country. There is no imperative demand upon any people to possess a Carrying Trade, a Shipbuilding Industry, or a Foreign Commerce. The carrying trade is an occupation of men who own or control ships, and differs from shipbuilding as carting does from wagon-building ; looked at broadly, the two interests are hostile, because shipowners wish to buy new vessels at low prices, to keep the competing vessels few in number, to maintain freights at the highest figures, and to buy cheap, good ships without regard to the nationality or locality of the builder. Foreign commerce is the exchange under varying conditions, the simpler the better, of the products of one country for those of another ; merchants want plenty of competing ships, and low freights, and to them it is a matter of indifference by whom the vessels are built, owned or navigated. In other directions these interests are correlated, and each is of great value ; but of all, commerce is the active principle, for lacking it, a country needs neither to own nor to build ships. Again, the carrying trade is an industry which, in itself, is neither more nor less desirable than any other, than shoemaking for instance ; and it is engaged in only because, for equal expenditure of labor and capital, more profit is promised than by any other business. Nor does it follow, if a nation had a commerce, and certain of its citizens found the carrying trade to be an advantageous employment for their labor and capital as compared with other industries, that other of its citizens ought to engage in shipbuilding. Any person may have a whim for owning

a ship built in his native country and be willing to pay for the gratification its possession affords; but if it costs him more to do this than to buy abroad, he has lost money "A fisherman," as Professor Sumner quaintly puts it, "who has caught nothing sometimes buys a fish at a fancy price. He saves himself mortification and gets a dinner, but the possession of the fish does not prove that he has profitably employed his time or that he has had sport."

Should a country own a foreign trade it would not necessarily be an object for it to do its own carrying, any more than it would be an object for a farmer to insist upon carting to market his own produce, when some person regularly employed in that business offered him a contract on better terms than his own. Quite as foolish would the man be who refused to carry on a carting business unless he could build his own wagons; and sunk in the deepest deeps is a nation which knows that certain of its citizens could buy and use carts so as to make a legitimate profit, and yet denies the privilege, because certain other equally as good citizens could not build similar carts at home for a profit.

Maritime success, or the possession of the elements which determine the fitness of a nation for marine enterprise, can no more be called a question of chance than can watchmaking; nor is there any uncertainty about the conditions which qualify a nation for eminence in navigation. It is subject to the same economic rules, and its genesis, development, and decay follow the same laws that underlie the evolution and growth of man. Certain impulses go to the establishment of these marine activities: if all exist, pre-eminence is assured; if some are wanting, there will be alternate periods of exaltation and of depression, and possibly of ultimate decadence; and if all or large numbers are absent, no outside aid, whether legislative or individual, can arrest the operations of the inevitable law. Trade may be forced, but all industries are nowhere less than contingent; and none of them can exist if certain natural conditions are lacking. Briefly generalized, the first impulse towards maritime enterprise arises out of life in a region which will not support its inhabitants by agriculture — "original poverty of soil or limited extent of territory almost arising to the heights of a necessary qualification" (Hall). The born navigators of the world have always lived in little, half-barren countries, situated in the midst of fruitful regions; the almost invariable rule being that those who inhabited a rich soil never engaged in navigation until the population became so

dense that agriculture would not afford sustenance to all. This was the case with the Carthagenians, the Greeks, the Latin races of Europe, the English, and among other people in America, the New Englanders. These last took to the sea because the shore did not furnish them with products which would remunerate their capital and labor equally as well; while on the other hand the people of the Southern States clung to the fruitful land, never fostered nor inherited a taste for the sea, and to-day do not own one-ninth of the ships under our flag.

Ocean fisheries affect the maritime fitness of a people by the training they give to sailors, and by their encouragement and exercise of those qualities which prepare mariners for the daring and difficult enterprises of their calling; in every age the fisheries have been the original temptations which induced men to go to sea, and the only nations that have been eminent in shipping have fished from the beginning.

It is an accepted law that an art-loving or an art-producing community does not display energy in commerce and industry; a roaming disposition, a love of adventure, a jealousy of participation in home affairs by foreigners, and a spirit of traffic and industry, invariably impel in the direction of maritime enterprise, and thus make it largely dependent upon the genius of a people.

It is only a region situated in the midst of great seas, and advantageously central, that can in the long run have the most ships and be supreme in commerce; this, which was so potent in the past, will have double significance in a future of general settlement of inhabitable lands. The flag of commercial enterprise shifts with centres of civilization and settlement; and of two nations competing for trade and navigation to a great market, that one in the end will secure the larger share which is the nearer or which has the better geographical position.

A great population and a large surplus of native commodities are essential to the permanency and greatness of a merchant marine. This does not preclude a certain trade being built up by small nations with a limited population and no commerce; for, as to-day in the North Countries, a people, forced from irresistible conditions to follow the sea, might find it profitable to prosecute a carrying trade; but under a limiting environment such an industry would be rarely permanent and never great. The wants and energies of a large native population develop trade; and when the genius of a people

is, as with most nations, one-sided—agricultural as opposed to manufacturing, for example—the laws of supply and demand, and the exigencies growing out of the ownership of a large surplus product, must ensure marine enterprise.

Abundant resources in material for ships; economy in ship construction and operation; capability of production for a definite sum less than rival nations; power, in the absence of this, of purchasing where they are best and cheapest; a wise policy of government—these, and all of these, go to the making of the ideal commercial nation.

Do we then possess this fitness, this capacity for maritime success? So far as commerce affects, this country has a vital interest in the carrying trade, let theorists befog the cool air as they may; every dollar paid for freight imported or exported in American vessels accrues to American labor and capital, and the enterprise is as much a productive industry as the raising of wheat, the spinning of fibre or the smelting of ore. Had the acquired, the "full" trade of 1860 been maintained without increase, $80,000,000 would have been added in 1880 to the national wealth, and the gain from diverted shipbuilding would have swelled this sum to a total of $100,000,000. Our surplus products must find foreign markets; and to retain them, ships controlled by and employed in exclusively American interests are essential instrumentalities. Whatever tends to stimulate competition and to prevent combination benefits the producer; and as the prices abroad establish values here, the barter we obtain for the despised one-tenth of exports—$665,000,000 in 1880—determines the profit or loss of the remainder in the home market. Is it generally known, for instance, that a difference in cost of a single penny in laying down grain at Liverpool may decide whether this product shall be drawn from the United States or from the agricultural districts of Hungary and Southern Russia? During the last fiscal year 11,500,000 gross tons of grain, oil, cotton, tobacco, precious metals, etc., were exported from the United States, and this exportation increases at the rate of 1,500,000 tons annually; 3,800,000 tons of goods are imported, or in all about 15,000,000 tons constitute the existing commerce of this country. If only one-half of the business of carrying our enormous wealth of surplus products could be secured for American ships, our tonnage would be instantly doubled, and we would have a greater fleet engaged in a foreign trade, legitimately our own, than Great Britain has to-day (Hall). The United States

makes to the ocean carrying-trade its most valuable contribution, no other nation giving to commerce so many bulky tons of commodities to be transported those long voyages which in every age have been so eagerly coveted by maritime peoples. If the larger proportion of this commerce consisted in articles of foreign growth and manufacture, it would not be strange to find foreign ships securing the larger share of the business; but of the 17,000 ships which enter and clear at American ports every year, 4600 seek a cargo empty, and but 2000 sail without obtaining it. Trade is largely governed by the social, industrial and economical conditions of the consumer. A careful study of the commercial relations of the British colonies of Australia, New Zealand and South Africa demonstrates that with them, notwithstanding the competition of the mother-country, there are splendid opportunities yet untried; last year the imports of the two former reached a total of $400,000,000, and their necessities demand the very articles we make most skillfully and supply most cheaply; and for return cargoes, Australia and the others have many things we want cheap and are forced to buy dear. In 1879 the former sent to England wool valued at $35,000,000, and in the next year we imported from England $23,760,000 of the same staple, obviously buying the Australian wool at second-hand for double freights and brokerages.

Ships are profitable abroad and can be made profitable here; and in truth, during the last thirty years no other branch of industry has made such progress as the carrying trade. To establish this there are four points of comparison—commerce, railways, shipping tonnage, and carrying power of the world—limited, for the sake of illustration, to the years between 1850 and 1880.

	1850.	1880.	Increase.
Commerce of all nations,	$4,280,000,000	$14,405,000,000	240 per cent.
Railways—miles open,	44,400	222,000	398 " "
Shipping tonnage,	6,905,000	18,720,000	171 " "
Carrying tonnage,	8,464,000	34,280,000	304 " "

In 1850, therefore, for every $5,000,000 of international commerce there were 54 miles of railway and a maritime carrying power of 9900 tons; and in 1880 the respective ratios had risen to 77 miles and 12,000 tons; this has saved one-fourth freight, and brought producer and consumers into such contact that we no longer hear "of the earth's products being wasted, of wheat rotting in La Mancha, of wool being used to mend roads in Paraguay, and of sheep being burnt for

fuel in making bricks in the Argentine Republic." England has mainly profited by this enormous development, the shipping of the United Kingdom earning $300,000,000 yearly, and employing 200,000 seamen, whose industry is therefore equivalent to £300 per individual, as compared with £190 gained by each of the factory operatives. The freight earned by all flags for sea-borne merchandise is $500,000,000, or about 8 per cent. of the value transported. Hence the toll which all nations pay to England for the carrying trade is equal to 4 per cent. (nearly) of the exported values of the earth's products and manufactures; and pessimists who declare that shipowners are losing money or making small profits must be wrong, for the merchant marine is expanding every year.

What then is our situation? We have been a great maritime nation, therefore we must have had some of the qualities essential to success; we have had a great commerce, a great shipbuilding interest, and a great carrying trade, hence our citizens must have found these industries profitable. The national genius for trade, adventure and enterprise has become intensified by the changes modern life demands; our fisheries are still profitable, whaling (owing to the petroleum production) alone excepted; every year our geographical position has improved, so that now we are the Great Middle Kingdom; our national resources in nearly every direction have quadrupled; our population, swelled last year by 600,000 emigrants, is so dense that our eastern coasts are overcrowded with people whose race requirements—sea-coast born or descended, as opposed to inland reared—demand a sea-environment; the carrying trade was never more profitable; our commerce has expanded so enormously that it is not only a question of profit but of serious necessity that we should manage it, from the growing of the blade to its freighting in every sea — and yet, with every impulse, every activity insisting that we should assume our place in the world, our Merchant Marine is in a state of decadence. Our people are not more profitably employed in other occupations, and therefore it must be in bad laws, apathy of government, or the lack of special resources that the causes will be discovered.

II.

The first vessels built upon our shores were intended exclusively for the fisheries and the coasting trade, the pioneer merchants being contented with the quick returns and small profits of a commerce

that was not controlled by exacting foreign governments. The vessels were necessarily small, and, though admirably fitted for their work, of the type struggling shipbuilders must perforce produce. As early as 1660 the fisheries off our coast had become so valuable that as many as six hundred sails were found upon the Banks during a season, and so great were the profits that the boats often paid for themselves in one voyage. Gaining confidence by successful rivalry in a trade which foreigners had aggrandized, the New England merchants extended their enterprises in other directions, and, before the Revolutionary War, they had built up a commerce which was substantially profitable not only on our own coast, but with Europe and the Spanish West Indies. The war naturally checked the growth of navigation; but, as a compensation, shipbuilding acquired so great an impetus from privateering, that when peace was established, there were nowhere more skilled or more intelligent ship-designers and mechanics than our own. At this time our shipping could not have exceeded 100,000 tons, though, as the government had no control over the registry until after the adoption of the Constitution, no definite knowledge is attainable. Foreigners, however, still controlled the best part of our trade, for at that time "the prominent fact," writes Hall, "was the preponderance of European bottoms in the foreign trade; in 1789 the registration was 123,893 tons; 68,607 in the coasting trade; 9062 in the fisheries; and there were still 100,000 tons of foreign shipping in the external commerce." The active social, political and economic principle of each nation in those days was eminently not fair dealing to other people; and the accepted theory of trade among the stronger nations was the imposition of such burdens upon the weaker maritime countries that the latter were certain to be driven from all but home ports. The new United States suffered particularly by this policy; and upon her entrance in the race of the trading nations, asserted as cardinal principles growing out of her political aspirations, freedom of commerce and entire reciprocity of intercourse. Treaties were sought, but in vain, until 1782, when the Dutch, after four years of negotiation initiated by Franklin and consummated by John Adams, signed a convention which gave the ships of both nations exact reciprocity in the ports of each other. At the close of the Revolutionary War an attempt was made to enter into a similar treaty with England, but after a vexatious delay of several years, not only was the offer rejected, but a policy more severe than that shown to any

of the European governments was adopted towards the new Republic. In July, 1789, the first Congress under the Constitution passed the celebrated Navigation Act, which, coming as it did from a weak country, imperilling a shipping unprotected by an adequate naval force, excited in Europe a most profound astonishment. That its enactment in part was retaliatory of England's attitude was never doubted, and at first there were threats that boded ill for the kin across the sea ; then came doubts, not of justice but of expedidiency, accentuated by the increasing appearances of American ships in foreign waters ; and finally negotiations, controversies and treaties ; these at first with England in 1794, then with Spain in 1795, and at last with France in 1800. Though the provisions of these treaties were not entirely satisfactory, yet they were movements in a right direction ; and so much was commerce stimulated that in 1800 seven-eighths of the freights was carried in American ships ; the home trade with China was exclusively our own ; and between 1798 and 1812, 200,000 tons of shipping beyond our needs were sold to foreigners. " Secure in the protection of our laws . . . our merchants entered upon the present century a class of prosperous men and full of confident anticipations for the future " (Hall). Shipping had increased in tonnage as follows:

Years.	Registered for Foreign Trade.	Coasting Trade.	Fisheries.
1789	123,893	68,607	9,062
1795	529,470	164,795	34,102
1800	669,921	246,295	30,078
1805	749,341	301,366	58,363

England, unable outside of protocols to look upon us as anything but rebellious colonists, still subjected our ships to such annoying visits and impressed so many of our seamen that, in twelve years, our merchants suffered great losses by the detention and crippling of their vessels—no less than 6000 men having been forcibly taken from the decks under our flag. A further interference with our commerce resulted from the blockade of the coasts of France and of the Netherlands, and from the subsequent publication of the Berlin Decree and of the English Orders in Council of 1806, and from the Milan Decree of 1807 ; in consequence of these necessities of foreign war, over 1660 American ships were captured, and either condemned with their cargoes or subjected to great losses by trade interference, high insurances and delays ; many of our vessels were forced to seek neutral harbors for protection, and were not only seized at sea, but were

searched at the mouths of our own harbors. America protested in vain, and finally passed the Embargo Act. In May, 1810, France repealed the Berlin and Milan Decrees, but Great Britain refused either to desist from her obnoxious policy of search, or to remove the prohibitions which forbade our ships seeking markets on the free coasts of Western Europe. As a very natural result the war of 1812 followed; it cost the government $150,000,000; it destroyed on land and sea thousands of lives and millions of private property, and at its close left us nearly bankrupt. In 1810 our tonnage was 1,385,000, and on January 1, 1815, we had lost in five years enough to raise its gross amount to 1,828,000 tons,—an increase of less than 100,000 tons annually; in three years 2300 of the enemy's vessels were captured, " but our privateers destroyed many of these, and 750 were retaken, and we in turn lost 1407 of our own merchant vessels and fishing boats, so that the balance was slightly in our favor." At last in 1815 England made a commercial treaty; and though poor in resources, yet strong with the instincts of a young and vigorous life, the nation entered the great race for maritime supremacy, fortified by the knowledge of its past, the justice of its present gained by blood and iron, and the hopes of its future pregnant with promise.

As a matter of policy, Congress, in 1817, substantially re-enacted the navigation laws of England; our coasting trade was prohibited to other nations; ships in the foreign trade, unless two-thirds manned by Americans, were taxed fifty cents a ton; and the great quadrangular trade of Great Britain to Brazil, the East Indies, United States and England, was cut off. At the same time a frank offer of general reciprocity was made in which America proposed to put commerce upon the high plane of fraternity among nations, and to leave all victories within that field of action to the intelligence and enterprise of the different peoples of the world. This was declined; and it was not until 1830, and after more difficulties with England and France, that we had direct trade and reciprocity with the principal commercial nations. From the peace of 1815 our commerce expanded in an extraordinary manner, increasing in money from $270,000,000 in that year to $480,000,000 in 1836; the annual travel and immigration rose from 20,000 to 75,000; and fifteen years later, in 1850, the ocean traffic of the United States gave employment to 2,335,000 tons of shipping—the total tonnage entering and clearing from our ports being 8,000,000. Nothing could supply more absolute proof of our fitness for the demands that a maritime

industry imposes than this victory over forces and circumstances, which in every disguise and under every opposing condition met us at each forward essay. Beginning at the end of the line, without a helping hand or an encouraging voice ; against obstacles that seemed insuperable ; in war ; during a neutrality that was worse than actual belligerency ; when harassed and fettered by cruel foreign impositions and discriminations, and impeded by the mistaken views of internal factions—yet, at the last, breasting the waves that were unbroken by rival keels, if not at the very head, yet missing it by so slight a degree that our co-equality was recognized—surely never before since the world began was there such a record, never such testimony to the genius and instincts of a people. A widening field of commerce, followed by equality of competition, aided us; the assertion of fair trading and of equal rights, emphasized by the splendid services of our navy, gave us a further claim to be heard; our mariners were the best in the world, and our ships, notwithstanding the higher wages paid, were navigated the most economically; our packet lines to Europe crossed in an average of less than twenty days, and American buyers could insure their goods in this country under the stipulation they should come in certain American ships; the British whale fisheries were extinct, while ours employed over 700 ships and 17,000 seamen; in thirty years this country built 3,900,000 tons of shipping ; all the mails and passengers and a large majority of the immigrants were transported under our flag; three-fourths of the cotton was exported in the same way, and best of all, the policy of the government was so aggressive that our flag was respected everywhere, and in certain trades, even under unequal conditions, had the preference over all competitors.

But from this period dates our decadence.

The maximum tonnage of this country at any time registered in the foreign trade was in 1861, and then amounted to 5,539,813 tons; Great Britain in the same year owning 5,895,369 tons, and all the other nations 5,800,767 tons. Between 1855 and 1860 over 1,300,000 American tons in excess of the country's needs were employed by foreigners in trades with which we had no legitimate connection save as carriers. In 1851 our registered steamships had grown from the 16,000 tons of 1848 to 63,920 tons—an amount almost equal to the 65,920 tons of England; and in 1855 this had increased to 115,000 tons and reached a maximum, for in 1862 we had 1000 tons less. In 1855 we built 388 vessels, in 1856 306 vessels, and in 1880 26

vessels—all for the foreign trade. The total tonnage which entered our ports in 1856 from abroad amounted to 4,464,038, of which American built ships constituted 3,194,375 tons, and all others but 1,259,762 tons. In 1880 there entered from abroad 15,240,534 tons, of which 3,128,374 tons were American, and 12,112,000 were foreign—that is, in a ratio of 75 to 25, or actually 65,901 tons less than when we were twenty-four years younger as a nation. This decadence did not originate in the war between the States, but dates from 1856, when it was detected in the decrease of sales to foreigners—65,000 tons having been transferred in 1855, 42,000 in 1856, 26,000 in 1858, and 17,000 in 1860. In 1879 we built 43,000 tons of registered vessels, but at the same time we relinquished 148,000. tons; this loss of 105,000 tons being distributed in 37,000 tons sold to foreigners (old vessels), 24,000 tons abandoned, and 87,000 tons lost. The grain fleet, sailing in 1880 from the port of New York, numbered 2897 vessels, of which 1822 were sailing vessels carrying 59,822,033 bushels, and 1075 were steamers laden with 42,426,533 bushels, and among all these *there were 74 American sailing vessels and not one American steamer.*

In 1856 the total exports and imports were $641,604,850, and in 1880 $1,613,770,663. In the first named year there were carried in ships built, owned, manned and commanded by Americans $482,268,274, and by foreigners $153,336,516; in 1880 Americans transported $280,005,497, and foreigners $1,309,466,596; the percentage of our carrying in our own trade was in 1856, 75.2; and in 1880, 17.4.*

In the general trade of the world our record is as lamentable. "At the beginning of the 19th century," writes Yeats, "the commerce of the world seemed passing into American hands, their shipping having increased five-fold in twenty years." "Their decline," continues

* Our domestic marine consists of about 25,211 vessels, aggregating 4,169,600 tons. Of this number 17,042 are sailing, 4569 are steam, 1206 are canal boats, and 2395 are barges. With respect to location they are distributed as follows: The Atlantic and Gulf coasts have 14,762 sailing vessels, aggregating 1,967,023 tons; 2162 steam vessels, 615,039 tons; 658 canal boats, 58,963 tons; 764 barges, 159,041 tons. The Pacific coast has 807 sailing vessels, 148,712 tons; 308 steam, 107,040 tons; 87 barges, 14,595 tons. The Northern Lakes have 1473 sailing, 307,077 tons; 896 steam, 203,298 tons; 549 canal boats, 44,774 tons; 170 barges, 42,226 tons. The Western Rivers have 1203 steam, 250,793 tons; 1373 barges, 251,015 tons.

Mulhall, "in recent years is unparalleled, as appears from the aliquot carrying power belonging to various flags.

Country.	1850.	1870.	1880.
Great Britain,	41	44	49
United States,	15	8	6
France,	8	8	7
Other flags,	36	40	38

"In size of ships America has now reached the mean attained by England in 1870, the average tonnage of all sea-going vessels afloat being in 1880 177 tons, or an increase in ten years of 36 per cent. in medium tonnage." Our relative position is shown exactly in the following table:

Country.	1870.	1880.	Increase—Tons.
British,	549	748	199
French,	210	320	110
German,	220	250	30
American,	405	560	155
Norwegian,	143	190	47
Italian,	135	156	21

While this poison of decay has been eating into our vitals, the possibilities of the country in nearly every other industry have reached a plane of development beyond the dreams of the most enthusiastic theorizers; we have spread out in every direction, and the promise of the future beggars imaginations attuned even to the key of our present and past development.

	1830.	1880.
Population,	12,000,000	50,000,000
Railways,	23 miles	8000 miles.
Cotton,	976,000 bales	5,500,000 bales.
Telegraphs,	none	100,000 miles.
Postoffices,	8000	40,000.
	1840.	1880.
Wheat,	84,000,000 bushels	460,000,000 bushels.
Wool,	35,000,000 pounds	225,000,000 pounds.
Cotton spindles,	2,000,000	10,000,000

We have a timber area of 560,000,000 acres, and across our Canadian border there are 900,000,000 more acres; and in coal and iron production we are approaching the old world.

		1842.	1879.
Coal	Great Britain,	35,000,000 tons	135,000,000 tons.
	United States,	2,000,000 "	60,000,000 "
Iron	Great Britain,	2,250,000 "	6,300,000 "
	United States,	564,000 "	2,742,000 "

During these thirty-seven years the relative increase has been in coal from 300 to 2900 per cent.; in iron from 200 to 400 per cent., and all in our favor. But this is not enough, for England, with a coal area less than that of either Pennsylvania or Kentucky, has coaling stations in every part of the world, and our steamers can not reach our Pacific ports without the consent of the English producers; even if electricity should take the place of steam, it must be many years before the coal demand will cease; and to-day, of the thirty-six millions of tons of coal required by the steamers of the world, three-fourths of it is obtained from Great Britain.

It is unnecessary to wire-draw statistics, but it may, as a last word, be interesting to show, with all our development, the nationality and increase of tonnage entering our ports since 1856.

Country.	Increase.	Decrease.
England,	6,967,173	
Germany,	922,903	
Norway and Sweden,	1,214,008	
Italy,	596,907	
France,	208,412	
Spain,	164,683	
Austria,	204,872	
Belgium,	226,277	
Russia,	104,009	
United States,		65,901

"This," writes Lindsay, "is surely no decadence, but defeat in a far nobler conflict than in the wars for maritime supremacy between Rome and Carthage, consisting as it did in the struggle between the genius, scientific skill and industry of the people of two great nations."

III.

Publicists differ both as to the causes and the remedies. In 1865 the first were oracularly referred to the war between the States; but in modern times the effects of war are generally less potent when the exciting cause is removed, and with us nearly every other industry has quadrupled. At the close of the Crimean war Russian commerce was said to have been destroyed, but with a favoring environment in the four years subsequent to the peace, the damage was so repaired that in 1860 48 per cent. more Russian ships entered English ports than ever before. In 1868 doctrinaires declared that the fluctuation of the currency was the destroying factor, but it is of record that our shipping declined more after the resumption of specie payments than in

the years when the fluctuations were greatest. Next followed the assertion that with the revival of general prosperity so many avenues were opened to profitable investment that no room was left for placing money in the carrying trade ; but money has become cheaper year by year, until now, with our shipping at low-water mark, the rate is but 4 per cent., and for government bonds (excepting the consols of 1907) practically lower. None of these is a fair reason, and as a matter of history the first actual decline dates from before the war, in a time of fair interest and no debts and when money was stable. Some writers find it in various fanciful reasons, and there are not wanting others who discover the real causes to exist in British gold, aided and abetted by an unholy trinity of American venality, a hireling press, and a great foreign insurance combination. But it requires little research to learn that the decadence must be ascribed to one or more of the following causes: 1. Substitution of steam for sails; 2. Use of iron instead of wood in shipbuilding; 3. Non-subsidizing of American lines; 4. Navigation Laws; and 5. Special Government and State restrictions.

In this country steam was first applied to the navigation of rivers, and in 1847 the steam-tonnage of the Mississippi Valley alone exceeded that of the whole British Empire; indeed, so great are the demands of our inland navigation that to-day it is claimed our total domestic steam-tonnage does exceed that of England. By 1840 serviceable lines of boats were plying between the principal commercial cities of the Atlantic seaboard, and between 1845 and 1851 American steamers were crossing the Atlantic ocean. In 1858 we had in all 52 steamers of 71,000 tons in the foreign and domestic trades, England at the same time owning 156 vessels of 210,000 tons burden, and the rest of Europe 130 of 150,000 tons. But in that year American competition broke down; and while we were left with only seven steam vessels in the foreign trade, England had 120 plying to the extremities of the earth. To-day foreigners have over two hundred steamers in the direct trade with the United States, while our country has less than fifteen steamers running across the Atlantic and Pacific oceans.

Shipping can not be measured merely by gross tonnage, for steamers, as determined by Leroy-Beaulieu, multiply the carrying power five-fold. They are cheaper than sailing vessels, as the birth-rate, death-rate and increase—"the vital statistics"—demonstrate. The ordinary life of a ship, allowing for extraordinary contingencies,

is, in the United States 18 years; in France 20; in Holland 25; in Germany 25; in Great Britain 26; in Italy 28, and in Norway 30. The annual average of wrecks for the seven years ending 1879 is as follows:

Country.	Steamers.	Sailing Vessels.
British,	2.94 per cent.	3.93
French,	2.47	4.04
United States,	4.06	5.45
Dutch,	3.84	4.49
German,	2.77	4.04
Italian,	1.74	2.94
Scandinavian,	1.96	3.20

Assuming three voyages yearly for a sailing ship and fifteen for a steamer, it appears that the former is lost once in 72 voyages and the latter once in 490; so that steamers have only one-seventh of the risk of sailing vessels. The death-rate of the world's shipping is 4 per cent., or 750,000 nominal tons; and the birth-rate is 5 per cent., the average of new vessels built being 950,000 tons; but even this does not give a correct idea, since the substitution of steamers for sailing vessels augments the carrying power 4 per cent. The vessels lost or broken represent 1,200,000 tons a year; and those built attain nearly double that number, as appears from Kaier's returns of the average since 1872, viz.:

Shipbuilding. Annual Average.

Dock Yards.	Steamers, Tons.	Sailing Vessels.	Carrying Power.
British	292,000	167,000	1,630,000
United States	15,000	118,000	193,000
Italy, Canada	35,000	324,000	499,000
	342,000	609,000	2,322,000

The efficiency of seamen measured by the number of tons they carry yearly will be found to have some relation to the quantity of merchandise borne by steamers, viz.:

Flag.	Seamen.	Tons Carried.	Per Seaman.	Steam Ratio.
British	141,440	61,100,000	436	76 per cent.
French	29,220	8,100,000	271	63 "
German	39,980	5,700,000	141	54 "
Italian	52,000	4,300,000	83	25 "
Various	446,000	38,000,000	85	41 "
	708,640	117,200,000	165	61 "

Ten years ago the average of tons carried by each British seaman was no more than 278, so that two men in 1880 do the work of three men in 1870; and further, ships are not sent to sea short-handed, as this might indicate, for the efficiency of the seaman has been indisputably increased; and the sea mortality of $3\frac{1}{2}$ per 1000 proves how much sanitary progress has gone hand-in-hand with the new conditions that demand superior intelligence. Some shipowners claim that owing to this very efficiency the carrying trade is overdone, and that the world could satisfy its commercial demands with fewer vessels; and though it is true that the ballast entries in Great Britain and the Continent have risen from $17\frac{1}{2}$ and $21\frac{1}{4}$ per cent. in 1870 to $19\frac{1}{2}$ and $22\frac{1}{4}$ per cent. respectively in 1880, still the building and employment of new ships disprove this statement. Tonnage movement, therefore, gives a better idea of national wealth than tonnage possession, for the tendency of trade is to transact business with that minimum of profit and that maximum of volume which render capacity and speed development essential. Twenty years since a vessel of 3000 tons on a voyage of given length had to allow 2200 tons for coal and machinery; but compound engines and structural and propulsion improvements have so reversed this that now but 800 space-tons are needed for motive power, and 2200 may be devoted to freight and passengers. In 1879 Great Britain built five steamers to one sailing vessel; and though a fair proportion of the world's commerce is still carried in sailing vessels, these figures seem to prove that except for very long voyages with bulky freights their days are numbered.

But even in sailing vessels iron ships are superseding wooden, and during the last five years, while we built 101,823 tons almost entirely for domestic trade, England put afloat 1,800,193 tons; and to-day still further complicates the problem by proposing the substitution of steel for iron.*

*"A recent English writer, in treating of the new application of steel to shipbuilding, illustrates the advantage of this material over iron as follows: Suppose the construction of a trans-atlantic freight steamer carrying 3500 tons (dead weight) is contemplated: if of iron, the hull will weigh about 2500 tons, and the entire ship will cost about $350,000; if of steel, the hull will weigh 2000 tons, the total cost being $380,000. Reckoning 6 per cent. interest and 6 per cent. depreciation, etc., on this $30,000 extra cost, we have $3600 per annum. As an offset to this, the writer estimates as an extra freight on the steel over the iron vessel 500 tons cargo out and 500 tons cargo back. Assuming ten trips per year, this would give 10,000 tons extra freight, which, at $3 average freight per ton, would make $30,000 extra earnings per year. Deducting from this the $3600, the balance of $26,400 represents the extra net profit per year that would be earned by the steel over the iron steamship, which is equal to $9\frac{1}{2}$ per cent. on the entire cost of the vessel."

In every important respect iron ships are more desirable than wooden: 1. They secure a higher classification and for a longer term of years; 2. They are maintained at less expense; 3. They carry more cargo on equal tonnage and obtain higher rates of freight; 4. They command the preference at the enhanced rates; 5. They are insured on better terms; and, 6. They are less liable to cause damage to cargoes

All parties will accept these as primary causes of the decay of our shipping, the practical influences of both being coeval with the evolution of new theories of commerce; but beyond these points of agreement there are two radical and embittered differences of belief, one pinning its faith to the dogma of free ships, and the other looking towards the Mecca of subsidies.

IV.

The protection or subsidizing of the American foreign trade is not a new idea in our experiments with political economy, the first appropriation dating from 1845, when $1,274,600 were *equitably divided* between several lines of steamers; under varying conditions and with increasing demands these bounties were continued until 1855, and then ceased, not to appear until 1865, when Congress subsidized Garrison's Line to Brazil, and, later, the Pacific Mail and Roach's Brazil Line. To develop commerce for the ships we could build was offered as the apology for the subventions in the earlier period; to foster shipbuilding as the most important element of commerce revival is claimed as their *raison d'être* in the later. But herein lies a fallacy; for while shipbuilding is of the navigation interests, it is not its rounded summation: commerce, carrying trade, postal service, and the maintenance of a school for maritime defense, being, if not superior, at least not subordinate. The profit of a ship in twenty years' cargo-carrying is fifteen times greater than her first cost, and, low as is our commerce to-day, more wages are distributed to sailors in a single week than all the shipbuilders pay their operatives in an entire year; hence, it is a curious study in political economy to find an illogical conclusion result in national interests being sacrificed to the policy of a few shipbuilders, and to see a great country rejecting a greater profit for a lesser because both cannot be obtained. "There is a familiar doctrine found in the Constitution of the United States and in the Constitution of every State," said Mr. Bayard in the Senate of last year, "which is the necessary outgrowth of the institution of

government itself. It is that the interest of the individual or few must give way to that of society at large. But where is the proposition, and where in any civilized government called free can you find the doctrine recognized, that public property may be taken for private use?" It is undeniable that under whatever form subsidies appear they tax the many for the few, and can be met only by new burdens upon the producer and consumer for the benefit of a privileged distributing agent; this protection means that the greater number of American shipowners must compete not only with foreign and home rivals, but with their own more favored countrymen who sit above the salt and receive exceptional favors from the Government; nay, more, it results in the nation itself entering into competition with the great body of shipowners and shipbuilders, whose contributions to the revenues are turned against themselves. When Congress compensates steamship lines for running at a loss, or pays the difference between the cost of running and what the owners consider a fair profit on their investment, the subsidized lines alone are profited, and the unprotected but restricted ships succumb in the unequal conflict. In nearly every case protected lines in the past have been beaten by unsubsidized but unrestricted foreign steamers; when the bounties ceased the lines stopped running, and while freights were not made cheaper, the results were to make the protected owners richer by the subsidy, to ruin the unprotected shipper, and to develop no foreign trade. During the ten years covered by Garrison's operations the value of our imports from Brazil doubled, and our exports increased but one-eighth, and for this solution of the economic question we paid $1,500,000.

"Whenever the question of ships is raised, the clamor for subsidies and bounties is renewed, and we are told again that England has established her commerce by subsidies. . . . . Some of our writers and speakers seem to be under a fascination which impels them to accept as authoritative examples the follies of English history, and to reject its sound lessons. In the present case, however, the matter stands somewhat differently. England is a great manufacturing town. It imports food and raw materials and exports finished products. It has therefore a general and public interest in maintaining communication with all parts of the world . . . . Subsidies to ships for the mere sake of having ships or ocean traffic, when there was no business occasion for the subsidized lines, would have no analogy with English subsidies" (Sumner). Yet the example of Great Britain is

invariably hailed as the clear, effulgent light whereby we may guide our stumbling footsteps, and we are asked to subscribe a few millions that we may replace England as a successful wooer for the commerce of the world. But even if our national conditions were as alike as they are dissimilar, an addition of 100,000 tons to our ocean tonnage, supported by a bonus of $3,500,000, would be only 5 per cent. of the steam fleet of Great Britain, and its total earnings would be but 2½ per cent. of the freight money she bids us stand and deliver on the high seas. England is a country whose greatness is in the dependencies that punctuate the page of the world; 200,000,000 of her people demand postal communications in colonies separated by leagues of sea, and her sea-concessions are analogous to what we have done in railroad-grants and mail-routes within our undivided territory. Of the £783,000 voted last year, more than one-half went for mail purposes, and not a guinea was tabooed to ships surveying mankind with commercial view, or built in any country from China to Peru; some of this bounty has gone to foreign ships under foreign flags, and her object has been, not to make Englishmen buy or build ships, but to force the colonies to recognize their indebtedness to the mother-country. France exports a good share of her manufactured goods in English-built ships, and Italy must necessarily do the same, as she has few others. Hence it seems certain, that for whatever reasons of policy and by whatever country this money is given, it is under no limitations to home-built ships or to foster home shipbuilding.

Our coasting trade, which includes the rivers and great lakes, now comprises about 19,000 vessels and 2200 barges, employing 70,000 men, and the competition is so great that the charges for transportation have been reduced to a point never before known. Hence no one prominently identified with this question seeks to alter in the least the conditions of this enormous industry. It is true that there are a few dissatisfied writers who demand entire and immediate freedom for ships and tariff, but the great majority of free-ship advocates do not seek such extreme measures of relief; they do not wish, for instance, to interfere with this domestic trade, believing that its monopoly of 60 per cent. of the whole shipbuilding, and the restrictions in size of the vessels to be bought in open market (nothing under 3000 tons for foreign trade), ought, with the revenues accruing from repairs, to double the income of shipbuilders, who will be carrying to a full development a reviving industry. For

years these shipbuilders have been protected, and each year fewer ships are built; subsidies have been tried, but commerce still languishes; the echoes of a world treating the great problem of supply and demand upon new principles have been heard and are unheeded; and therefore is it that many men believe that a remedy exists, first, in the repeal of the navigation laws, and, secondly, in the removal of those other restrictions which have helped to throttle the fairest promise of modern days.

These navigation laws, so often quoted and so little understood that few of the laity can distinguish accurately between enrollment and register, and the best legal talent has been at fault in correctly defining the proper way of transferring the license of a pleasure-yacht from one collection district of the United States to another, can be found under title 48 of the Revised Statutes, Regulations of Commerce, chapters one to nine, and in various scattered sections of the law and of the Treasury Regulations. After our establishment as a nation, the questions of Slavery, Trade, and States Rights were the great sectional issues, and our Constitution and the earliest statute laws were, to a large extent, the result of compromises between these antagonistic ideas; indeed, that admired clause which provides no religious test shall ever be required as a qualification for office, as well as the first amendment, which forbids the establishment of religion or the prohibition of its free exercise, were merely parts of a general political necessity, restricting the functions of the federal government, and leaving to the several States as much of their separate sovereignty as was consistent with the existence of the Union. A larger belief in the rights of conscience did not engender this liberality, and the reasons of policy which forbade the federal government to meddle with slavery applied with tenfold power to questions of religion. So with the navigation laws, for they originated in a compromise between the slave-supplying and the slave-holding sections of the country; and the power to regulate commerce was inserted with, and, as a consideration for the extension, by New England votes, of the slave-trade until 1808, and for the prohibition of export duties. Though the Middle States and Virginia and Maryland protested against the infamous bargain, New England demanded from the first Federal Congress assembled under the Constitution her share of the disreputable compact; and thus, conceived in iniquity and reared in sin, the present navigation laws have cursed our generations with more than Biblical prophecy. It is but fair to

add that their final enactment was in some degree retaliatory upon the illiberal policy which England pursued for the destruction of our trade with the West Indies ; our triumph galled the British jade, and wincing, she did not look placidly upon our unwrung withers, though Pitt, with a small following, did attempt to liberalize trade upon the high seas. Protesting against concessions, Lord Sheffield, who, among others, was in 1783 blatant in two-penny opposition, advised the government to deal gently with the erring corsairs of Barbary, as the operations of these discriminating cut-throats would be confined mainly to the destruction of the commerce of America and that of the weaker Italian states. Others preached a fine philanthropy, publicly entreating the British lion and the American lamb to lie down together in peace, and privately praying that the lamb might be inside of the lion.

Somewhat curtailed, the navigation laws may be summarized as follows: No American is allowed to import a foreign-built vessel in the sense of purchasing, acquiring a registry, or using her as his property ; the only other imports, equally and forcibly prohibited, being counterfeit money and obscene goods. An American vessel ceases to be such if owned in the smallest degree by a naturalized citizen, who may, after acquiring the purchase, reside for more than one year in his native country, or for more than two years in any other foreign state. An American ship owned in part or in full by an American citizen, who, without the expectation of relinquishing his citizenship, resides in any foreign country except as United States Consul, or as agent or partner in an exclusively American mercantile house, loses its register and its right to protection. A citizen obtaining a register for an American vessel must make oath that no foreigner is directly or indirectly interested in the profits thereof, whether as commander, officer, or owner. Foreign capital may build our railroads, work our mines, insure our property, and buy our bonds, but a single dollar invested in American ships so taints as to render it unworthy of the benefit of our laws. No foreign-built vessel can enter our ports and then sail to another domestic port with any new cargo, or any part of her original cargo, that has once been unladen previously, without touching at some port of some foreign country, under penalty of confiscation. This law is construed to include all direct traffic between the Atlantic and Pacific ports of the United States *via* Cape Horn, the Cape of Good Hope, or the Isthmus of Panama ; and being a coasting trade, foreigners cannot compete.

An American vessel once sold or transferred to a foreigner, can never again become American property, even if the transaction has been the result of capture and condemnation by a foreign power in time of war. Vessels under 30 tons cannot be used to import anything at any seaboard town. Cargoes from the eastward of the Cape of Good Hope are subject to a duty of 10 per cent. in addition to the direct importation duties. American vessels repaired in foreign ports must pay a duty on the repairs equal to one-half the cost of the foreign work or material, or pay 50 per cent. *ad valorem*, the master or owner making entry of such repairs as imports. This liberal provision, which dates from 1866, is made to include boats obtained at sea, from a passing foreign vessel, in order to assure the safety of our own seamen. No part of the proper equipment of a foreign vessel is liable to duty, except it be considered redundant; thus when two sets of chains were found upon such a vessel, one was made chargeable with duty. Foreign vessels arriving here in distress, with loss of equipment, must pay duties on the articles imported for repair; if they need sheathing, 45 per cent. is exacted for the new copper used, and 4 per cent. for the old copper removed. In one case a foreign vessel left her mooring chains of foreign manufacture on an American wharf, and with great alacrity duties were immediately and lawfully collected on them as importations. If a citizen buys a vessel of foreign build stranded on our coast, takes her into port, repairs and renders her serviceable, she cannot become American property unless the repairs amount to 75 per cent. of the whole value of the vessel. Except in the fisheries, all our vessels engaged in foreign trade must pay annually a tax of 30 cents a ton; a ship of 1000 tons, for instance, contributing $300, which represents the profit and interest of $5000 at 6 per cent. Vessels belonging to foreign states having commercial treaties with us pay the same tonnage dues; but if an alien becomes an owner, even to a fractional amount, in an American ship, not only does the latter lose her registry, but the foreign privilege is void, and the joint ownership is charged with a tax of sixty cents a ton. If a picnic party comes into an American port in a foreign vessel—on the great lakes, for example, in a Canadian steamboat—such vessel becomes liable to a tonnage tax. Though the act of 1872 made free all material necessary for the construction of ships in this country for foreign trade, such vessels cannot engage in domestic trade for more than two months in any one year without payment of the duties, for which

a rebate was allowed. Canal-boats crossing the Hudson river, or any other navigable stream, are making a coasting voyage, and must be enrolled and licensed as coasters; in default of such precautions they have been seized, and released only after much delay and upon the payment of a fine. A foreign private yacht, touching at different parts of our lake or sea-coast, and carrying passengers—members of other hospitable clubs—can be punished for violating the laws of domestic trade.

Such, briefly sketched, are some of the laws under which a free people live, and for their repeal the historic bill, No. 724, was introduced by Senator Beck on the 27th of January, 1880. Stripped of its official verbiage, this proposed measure enacts that certain provisions of the statute law be repealed, and that hereafter it shall be lawful for our citizens to purchase ships built in whole or in part in any foreign country, and to have them registered as, and accorded the privileges of, ships built wholly within the United States and owned and controlled by our citizens. It being a debatable question whether the full measure of relief could be proposed anywhere save in the House, under its power to originate money or revenue bills, all provisions relative to tonnage dues, local taxation, bonded ship stores, and free material for construction and repair, were purposely omitted.

Other evil agencies are at work, and the repeal of such of the laws as apply to foreign trade is only the first step; prominent among these are consular fees, compulsory pilotage, state and local taxation, personal liability, determination of tonnage capacity, shipping, discharge and transportation of sailors, and protective duties upon shipbuilding materials. The limits of this argument forbid any but the following brief hints: For the year ending June, 1880, the Treasury received, mainly from American ships, $592,161; these fees, the interest of $10,000,000, being established that the consular service may be self-supporting, and not, as in England, maintained by the nation. Pilotage to New York is more than double that to Liverpool, and with a thorough appreciation of the energy, skill and sacrifices of our pilots, it seems somewhere wrong that the Sandy Hook service, composed of one hundred and thirty-three New York and fifty-eight New Jersey members, should have received last year between $800,000 and $1,000,000, or a mean average of over $5000.*

* "The committee declared the pilot service a monopoly. The pilot fees are fixed by law, and can only be changed by act of the Legislature; they were increased in 1865, in consequence of the gold premium, about 50 per

If compulsory pilotage be necessary—and this just men deny—how can the smaller merchant thrive under a system which makes it as expensive to bring a vessel into our harbors as it does to pay her captain for a round voyage to the West Indian ports? In this country ships are assessed as personal property, in New York at a 60 per cent. valuation. The annual profits of a steamship costing $500,000 may be assumed to be $25,000, and her taxes in New York, at a 2½ per cent. rate on $300,000, will amount to $7500, or 30 per cent. of the average profit; in England the income of the ship alone being taxed, about $500 will satisfy the government's demands, and the ownership of a vessel that is idle or unprofitable does not entail the burdens which must weigh upon vessels assessed and taxed under the same conditions as real estate. According to the British mercantile rule, the tonnage capacity of vessels is measured only on cargo space, allowance being made for quarters and machinery; with us the space occupied by the galley and closets is alone excepted, and as a consequence our ships suffer, not only at home, but in ports where harbor duties and light-money are

cent., with an understanding, had with the merchants, that it should be for three years only, but this three-year clause was subsequently stricken out of the bill by act of the Legislature, and the fees have since remained as follows (the rates fixed by the act of 1853 and prevailing till 1865 being added for comparison):

	Inward. Per Foot.	*Outward. Per Foot.*
For every vessel drawing less than 14 feet,	$3 70	$2 70
For every vessel drawing 14 feet and less than 18 feet,	4 50	3 10
For every vessel drawing 18 feet and less than 21 feet,	5 50	4 10
For every vessel drawing 21 feet and upward,	6 50	4 75

"If a vessel be moored within Sandy Hook or detained at Quarantine the pilot is entitled to his discharge and to full pilotage fees. When boarding a vessel beyond the sight of Sandy Hook Lighthouse the pilot is by law entitled to charge 25 per cent. in addition to the regular fee. This 'off-shore pilotage,' however, has been declared illegal by judicial decision, and is no longer collected unless specially agreed to by the master of the vessel. Between the 1st day of November and the 1st day of April $4 is added to the pilotage of every vessel coming in or going out of port.

"The committee presented a statement showing fees paid at several of the leading European ports, none of which are as easy of access as the port of New York. A ship drawing 21 feet in and 23 feet out has to pay for pilotage in and out at the port of Liverpool, $67.44; London, $147.55; Bristol, $125; Bremen, in summer, $55.85; Bremen, in winter, $88.79; New York, in summer, $245.75; New York, in winter, $253.75. The Sandy Hook pilot service comprises 22 boats belonging to the State of New York and 7 belonging to the State of New Jersey, the 29 having an estimated value of $300,000."—*From Report of Special Committee Chamber of Commerce, New York City.*

levied. Sailors discharged in foreign ports receive three months' pay regardless of character or of the fact that most of them are foreigners, many of them beach-combers, who double their wages by such tricks, and that all of them are at home in any part of the world.

Thirty-odd years ago the commerce of the world was carried in sailing vessels, and it was no idle boast when Americans claimed that England was lagging in the great ocean race, because of our superior build and management of vessels. In many important trades our magnificent clippers were the favorite ships, and the great commercial interests of England became so involved from the want of like vessels that remedial measures became necessary. But England was shackled by navigation laws, the first dating from 1380, and, strangely enough, offering as a panacea for existing evils "that no subject of the king should ship any merchandise, outward or homeward, save in a ship of the king's allegiance, on a penalty of forfeiture of vessel and cargo." Since Cromwell's time offensive prohibitions, not unlike our own, had existed on her statute books, broadening down from age to age by that precedent so dear to the English heart; and in 1849, when the reform was finally debated, such men as Disraeli, Brougham, and Bentinck declared that free trade in shipping would ruin shipowners, drive the British sailor into prospering Yankee ships, and destroy the shipbuilding interests of Great Britain. Brougham, skilled in brilliant misinformation, avowed that the navigation law was not only the corner-stone of England's glory, but the foundation of her very existence; and Mr. Disraeli closed his protest against the expected arrival of the same old New Zealander by airily promising that "he would not sing Rule Britannia for fear of distressing Mr. Cobden, but he did not think the House would desire Yankee Doodle." Shipowners sold their vessels at ruinous rates, forswore the sea, and implored Parliament to save them; but in vain the protests and petitions, for the intelligence of the country was aroused on behalf of its pocket, and by a good majority the cause of progress triumphed. Thirty years since England was more free than this country is to-day, and when, in 1856, the restrictions upon her coasting trade were removed, she was in a position that our most enthusiastic free-ship men do not hope for in the lustrums yet to be. England's new policy paid, for from 1840 to 1879 her tonnage movement, that is, the entrances and clearances of English ports, grew from 6,490,485 tons to 30,943,506 tons, or an increase of 476 per cent.

All other nations have the power of buying ships for foreign trade in the cheapest market, and the effort to protect our shipbuilders by the denial of this right forbids the return of commercial prosperity. In the coast trade, foreign interference can be excluded, but upon the high seas our rivals cannot be taxed; we labor under the disadvantages of traditionally higher wages and better rations; but the same skill which enabled us up to 1860, with well fed, well paid and more intelligent crews, to overcome these difficulties, will not desert us now. By treaty we grant to Germans trading in ships of any build every right allowed our citizens in American built ships. Norway and Sweden, under commercial treaties, claim every privilege conceded to the Germans; and as France and England are granted by law all concessions yielded to the most favored nations, we have practically given the maritime peoples the power to compete freely with free ships for a trade we deny our merchants. Under this dispensation our seaboard cities have become stations where foreigners may loot our producers; we survey, buoy and police our harbors mainly for foreign guests; and our grand lighthouse system holds out to burn so that these sinners against our greatness may return, unregenerated, unrepentant, and voracious for more of our material advantages. This is an agricultural country, nine-tenths of our products for export being no further advanced in manufacture than hogs idealized into pork, and wheat transmuted into flour, which, being as perishable as they are beautiful, must go abroad. To the monopolists, free ships or ships protected mean nothing; but to the farmer, transportation reads profit or loss, life or death almost. Millions are annually appropriated for railways, canals, river and harbor improvements, simply to move crops which, arriving at the seaboard, find a lame and impotent conclusion in foreign ships, ruled by a combination of home railways and alien shipowners and insurance companies. As a rule, competition eastward keeps down the price, but a syndicate of railroad men, charitably excited by our necessities, can tax the country millions of dollars by increasing freights a few cents a bushel on wheat and a dollar a ton on other articles, which find at the home ports, not three thousand ship-captains bidding for cargoes, but a secret agreement like that of 1873, when the great transatlantic lines pooled and bled the country of millions.

Free ships foster American interests, while the other policy develops, and will develop, the material greatness of other countries. There is no injustice of indiscrimination in subjecting to a high rate of duties

commodities imported separately while allowing the vessels composed of these articles to be imported free, *for the former are thrown upon a protected market where the burden can be distributed, and the latter compete in open market with ships that are unrestricted.* We will not buy the condemned ships of England, and it is fair to suppose that the same judgment in the employment of a means to an end will be exerted here as in any other path where every justly balanced and economic element must be considered.

This great national question bears a special meaning to the service, for no law is better defined than the correlation and interdependence of the mercantile and naval marines. Honest men differ honestly as to causes and to remedies, and the way is not always clear; but fairly considered it seems that in the generalization of free ships lies the answer to the great economic enigma; its literature is open to all, and the examples of our past and the past of other nations are of history. Superiority in the carrying trade is not due to the facility with which steamers can be built, nor to any one of a half-dozen different elements; the books of the shipbuilders of the Tyne and the Clyde show that they build vessels as readily for other nations as for their own; and in explaining this, an English writer declares that if the Americans had ten years ago repealed their suicidal Navigation Law, and bought or built a steamer for every British steamer built on the Clyde, they would to-day be in some position to compete with England in the carrying trade, instead of having to deplore their present state of destitution. "The effects produced by changes in the conditions of an industry are inevitable, and cannot be avoided by legislation; the only solution that gives, is to cause the loss to fall on some other set of people instead of on those directly interested. Again: it is evident that a country needing a protective tariff on iron and steel cannot expect to supply ships for ocean traffic at the low price of competing constructors in countries of no tariff. For the country which by hypothesis needs a protective tariff on iron and steel cannot produce these articles as cheaply as some other country. Its ships, however, must compete upon the ocean with those of the country which has cheap iron and steel. The former embody a larger capital than the latter, and they must be driven from the ocean. If then subsidies are given to protect the carrying trade when prosecuted in ships built of protected iron, the loss is transferred from the shipowners to the people who pay taxes on shore. These taxes, however, add to the cost of production of all things

produced in the country, and thereby lessen the power of the country to compete in foreign commerce. This lessens the amount of goods to be carried both out and in, lowers freights, throws ships out of use, checks the building of ships, and the whole series of legislative aids and encouragements must be begun over again with a repetition and intensification of the same results" (Prof. Sumner).

The men who ask for free ships are not the reckless theorizers their adversaries claim, and what they ask can be best exhibited in the particularized items, submitted in a late memorial to Congress:

1. The admission to American register of all ships over 3000 tons, subject to the same laws regarding ownership that now prevail.

2. The admission of all materials to be used in construction and repair of vessels of over 3000 tons duty free.

3. The adoption of new tonnage measurements, based on actual carrying capacity and excluding the space occupied by engines and boilers and accommodations for officers and crew.

4. Exemption from taxation, local and national, on all vessels engaged in the foreign trade for more than eight months of the year.

5. Permission for all American vessels in the foreign trade to take their stores and ship-chandlery out of bond duty free.

6. A general revision of the laws relating to seamen and to the consular service.

As already shown, the advocates of both the great theories of relief accept all these conditions, save the first and second, as absolutely necessary for the regeneration of our merchant marine; nay, many go so far as to find the second so little a matter of dispute that the adverse views may be said to separate only upon the first. Taken generally, the demands as formulated are moderate, and fairly represent the *juste milieu*, the golden mean, that has been attained by concession through the belief that anything more radical would not, under our governmental theory of taxation and with the existing conditions of the industries themselves, be justifiable. By the proposed remedies an American is enabled to buy his ship in the best and cheapest market, and to place it under the protection of a flag that is in little danger of war from outside complications. At the same time, under the restrictions of ownership, no foreign power, Great Britain for example, whose safety-valve and temper-check are in her carrying trade, would be able in war to place her navigation interests under our protection without relinquishing ownership; and alarmists may therefore be certain that she will not be able to resort

to the well-known process of whitewashing—a system of bills of sale with counter-mortgages—while holding fast to our legitimate opportunities.

What is more, both by original constructions and repairs, shipbuilding would, under the liberal plan proposed, be stimulated, and not only would the corps of skilled workmen be retained, but private shops filled with eager apprentices must, of the necessities of the case, spring up wherever coal and iron and deep water-fronts made shipbuilding feasible.

V.

Other remedies have been suggested, and they run the gamut of theory, from the wildest license of Free Trade to the grimmest asceticism of Protection. These admit only of the briefest notice. One is a change of policy with respect to international trade, a revival of the law of 1817 which forbade any ship to bring a cargo to the United States except from the ports of the country to which it belonged. This policy might result in profit with South America and Asia, for those countries own few ships trading to the United States, and we have commerce with them; but England and the other maritime nations would doubtless respond by a like enactment, and deprive our ships of nearly all the general trade we have outside our own country. As this is a simple question of what will pay best, this proposed relapse into the practices of barbarism need not be considered here; neither would it be germane to call it, in this age of private enterprise, the employment of a policy that characterized the idyllic days when every essay was seconded by the sanction and effort of paternal government; though as a matter of demonstrable fact it might be sufficient to affirm that we would lose much, and not even get the credit of being martyrs to progress.

Mr. Blaine solves the problem by bounties, for this purpose enacting a general law that ignores individuals and enforces a policy. His scheme provides that any man or company of men who will build in an American yard, with American material, by American mechanics, a steamship of three thousand tons, and sail her from any port of the United States to any foreign port, he or they shall receive, for a monthly line a mail allowance of $25 per mile per annum for the sailing distance between the two ports; for a semi-monthly line $45 per mile, and for a weekly line $75 per mile. Should the steamer exceed three thousand tons, a small advance on these rates might

be allowed; if less, a corresponding reduction might be made, keeping three thousand as the average and standard. Other reformers propose a bounty to be given by the government to the shipbuilder so as to make the price of an American vessel the same as that of a foreign-bought, equally good but presumably cheaper, ship. This will be brought about positively by hard cash, negatively by discriminative duties. There are a few enthusiasts, generally socialists and foreigners, who will be satisfied with nothing less than both the immediate abolition of all duties—not even retaining a modest tariff on luxuries for revenue—and the opening of the coast and domestic trade to the world. And last of all, at the other swing of the pendulum, there are kindred spirits who would abolish seamen, ships and seas, turning the last, for the eternal and cloistered happiness of America, into walls of fire that would ban the foreign commercial invader.

What is most wanted is action, action, action! From the beginning of the war to this hour Congress has not passed a single act to uphold the foreign carrying trade, and during the same time it has enacted ninety-two laws in aid of internal transportation, has given in public lands an acreage larger than that of the original States, and has added $70,000,000 in money. A thorough-going Congressional investigation of the whole subject of our commerce, manufactures and navigation would be of great service in enabling merchants and the government to co-operate harmoniously and intelligently. It would bring about a better understanding between the agricultural, industrial and mercantile classes, and, revealing the directions in which effort should be expended, it would tend to give us what we greatly lack and so much need, "*a national policy with respect to navigation.*" Something should be done to make the ocean mail service bring a fair return to the carriers; as our theory is that postages shall be rated so as merely to pay expenses, it does not seem fair to an important and admirable service that the $400,000 of receipts over expenditures for foreign mails should be retained by the government for the benefit of star routes that begin and end nowhere; other conditions being equal, give the mails to our own lines, pay a fair price for their transportation, and above all things release our ships at once from the existing burdensome postal restrictions.* Rigid inspections of vessels

*The merchant vessels of the United States are compelled by law to carry all mail offered to their masters by postoffice authorities here and by consuls abroad, and to accept such compensation as Congress directs. "The necessity

should be imperative; so that in the event of a change in the Registry laws, no vessel could be admitted to the benefit of our protection that would not be so well-found and serviceable as to entitle her to a high rating.

In Free Ships with the co-ordinate measures of relief is the only solution of the problem submitted for discussion and proof. As yet the popular voice is not hoarse from singing of anthems in favor of the policy, and in high places there is much contemptuous denial of its claims; but an active and an able minority believes that the cause is just and worthy of fighting for, and that in the end success is certain to come. Sketching the repeal of the Corn Laws, Buckle writes: "Those who knew the facts opposed the laws; those who were ignorant of the facts favored the laws. It was therefore clear that whenever the diffusion of knowledge reached a certain point the laws must fall . . . . The opposition the reformers had to encounter was immense, and although the principles of Free Trade had been established for nearly a century by a chain of arguments as solid as those on which the truth of mathematics is based, they were to the last moment strenuously resisted."

This instinct for our country's good through that larger freedom and more equal justice for all men which vivifies this question, has had just such a past, and is finding just such a present; but to those who watch, there are not wanting signs and portents of an equal triumph for its future.

December 29th, 1881.

of delivering the mails is frequently a source of delay and great expense to a ship . . . whose plans upon touching at some port for telegraphic advices from home may be changed by the owners. No matter what the trouble, the ship is compelled to deliver the mails assigned, or forfeit all the rights and privileges of a vessel of the United States." Stages and wagons receive an average of $28 per mile of route per annum; coast and river steamers, $43.50; railroads, $131—the compensation to these last ranging all the way from $35 to $538, $897 and $1155. Merchant vessels get only about $1 per mile per annum,—the American steamers from Philadelphia to Liverpool receiving for instance about 80 cents.

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COMMANDER H. B. ROBESON in the Chair.

OUR MERCHANT MARINE; THE CAUSES OF ITS DECLINE, AND THE MEANS TO BE TAKEN FOR ITS REVIVAL.

By MASTER C. G. CALKINS, U. S. N.

"*Mais il faut cultiver notre jardin.*"

I.

The existence of the shipping required for the ocean carrying trade of the world is essential to the continuance of the present form of civilization. The wants of mankind can only be supplied by the interchange of the surplus products of different nations. In the words of an eminently clear-headed writer: "Where open communication is preserved among nations, it is impossible but the domestic industry of every one must receive an increase from the improvement of the others." The sudden destruction of the fleets engaged in the ocean commerce of the United States would bring starvation to many densely populated districts abroad, and would leave 10 per cent. of our total agricultural produce to depress a market already fully supplied; while the supply of many articles which have become necessaries of life would be cut off.

An efficient merchant marine confers certain special advantages upon the nations which share its ownership. Pointing out the importance of the navigation of the United States at the beginning of its history, Jefferson said: "As a branch of industry it is valuable; as a resource of defense, essential." The distinction here made is important and will be observed hereafter.

The first element of value in the maritime industry is the immense sum earned in transporting international ocean freight. More than $500,000,000 is earned annually in this service, and the shipowners of Great Britain receive about one-half of this total. The exports and imports of the United States pay more than $130,000,000 annually, less than one-fifth going to American vessels. Two-thirds of this sum, being freight on goods exported, was paid by the foreign consumers of our products. Had it been earned by our own ships, it might be added to the balance in our favor in our foreign trade. It has been computed that the receipts for freight and attendant charges have nearly restored the apparent adverse balance in the trade of Great Britain during the last twenty years. A considerable sum is also earned by carrying passengers, and a much smaller amount by carrying mails; but the freights amount to 90 per cent. of the earnings of the world's shipping, while the mail pay is probably less than 1½ per cent. A nation which cannot carry her own ocean freights may have her commerce interrupted, with the result of depressing values and inflicting privations upon her people. This may happen whenever the power owning the shipping employed becomes involved in war, or adopts a policy hostile to commercial and maritime prosperity.

The importance of the merchant marine as a means of defense is not less manifest than its wealth-producing qualities. By training men to the sea it performs the most important part of their preparation for the naval service. This is done without expense to the nation and without withdrawing them from productive employment. The vessels of the merchant marine and the shipyards and machine-shops supported by it form a valuable material reserve for the navy.

The competition of a healthy mercantile marine will solve many problems in regard to speed, marine economy, and the use of new materials, that cannot be solved by the navy. The construction and efficiency of our men-of-war depend largely upon the state of maritime knowledge among our people and legislature. The display of the national ensign in foreign waters by improved and powerful merchant vessels raises the general estimate of our national power and resources and secures respect for our rights. The influence of a flourishing merchant marine in promoting the peaceful settlement of international difficulties has been indicated by the least prejudiced of English statesmen. Referring to the concessions by which France terminated a dispute with the United States during the

administration of General Jackson, Cobden said: "France knew that America had the largest mercantile marine; and, though at first the battle might be to the stronger in an armed fleet, in the end it would be to that country which had the greatest amount of public spirit and the greatest number of ships and sailors." Our reputation for public spirit will soon be our only support in similar cases.

Considering, therefore, the economical and defensive value of a prosperous merchant marine, we may accept the opinion of Colbert when minister to Louis XIV. He declared, in speaking of the ocean carrying trade in 1669, that each nation ought to share in it in proportion to the power, the numbers of people and the extent of seacoast which such nation possessed. A brief summary of the history and present condition of our merchant marine will show how nearly we have approached this standard.

II.

It would be impossible to hope much for the future of our maritime interests had we no record of past successes to fall back upon. The skill and energy displayed in nautical enterprises by the inhabitants of the North American colonies of Great Britain had built up an important trade before the colonies declared themselves independent. The growth of this trade was hampered by some natural disadvantages, but its principal obstacle was the commercial policy of restriction and oppression pursued by England.

The provisions of the famous Navigation Act closed the colonial ports to all foreign vessels, prohibited the importation of European goods from any country but England, and the exportation of sugar, cotton, tobacco and other valuable staples to any foreign country. Under such regulations the trade of the colonists naturally tended to overstep the bounds of law. The valuable traffic with the Spanish colonies was generally illegal. The rapid growth of American commerce after the close of the war with France aroused the jealousy of British merchants and the suspicions of the ministry. Burke says: "The bonds of the act of navigation were straitened so much that America was on the point of having no trade, either contraband or legitimate." This harassing policy excited great discontent in the colonies, and threw the most enterprising merchants and mariners in the ranks of the revolutionary party. The act of navigation was denounced as a capital violation of the laws of nature and justice by a leading delegate from Virginia in the first Continental Congress.

The protracted severities of the Revolutionary contest almost destroyed our struggling merchant marine, but the return of peace witnessed its prompt revival. Our envoys were sent to Europe, empowered to offer perfect reciprocity to foreign powers in removing restrictions on shipping. The treaty with Holland, signed in 1783, was the earliest formal recognition of this enlightened principle of commerce. The same terms were sought from Great Britain, and our proposals were favorably received by the ablest English statesmen.

In March, 1783, only a few weeks after the signature of the preliminaries of peace, William Pitt, then Chancellor of the Exchequer, brought in a bill for the provisional regulation of trade with the United States. The preamble recites the recognition of the late colonies as free, independent and sovereign states, and declares the expediency of establishing intercourse between the two countries on the most enlarged principles of reciprocal benefit. It then provides that vessels bringing goods from the United States to any British or colonial port shall be subject to the same charges and restrictions as British vessels entering the same ports. The bill failed with the overthrow of the ministry, and a revival of bitter feeling destroyed all chances of its passage. But it is worth remembering as embodying the wishes of the wisest public men on both sides of the Atlantic.

The responsibility for this failure belonged to the malignant Tories and interested shipowners of Great Britain. Its immediate results were the adoption of retaliatory measures by our government and the destruction of our trade with the British West Indies, causing the starvation of 15,000 slaves in Jamaica alone within a few seasons. Among the more remote results of this action, the international jealousy which brought on the war of 1815, obstructed our interests with Great Britain for more than half a century, and still supports the maintenance of a restrictive maritime system which is now suicidal, may be pointed out.

Trade was, however, rendered possible by the issue of annual proclamations suspending some of the more stringent provisions of British law. Our shipowners were ready to avail themselves of every opportunity, however grudgingly it might be granted, and our merchant marine began to thrive.

The first return of the shipping of the United States was made in 1789, but those for the next year show a rate of increase so incred-

ible that it is better to begin with the returns of the year 1790. The advocates of restrictive legislation, however, prefer to use the figures of 1789 to show a large percentage of gain during the next few years. The total tonnage in 1790 was 478,377 tons, of which 346,254 tons were registered for foreign trade. Hereafter the registered tonnage alone will be compared to demonstrate the progress of our merchant marine. The returns of the coasting trade include an immense tonnage of barges, canal boats, river steamers and other non-nautical vehicles which do not belong to our subject.

Our shipping increased with great rapidity during the next ten years, and its tonnage was more than doubled by 1804. The skill and enterprise of our mariners and shipbuilders, the abundance of the best materials for construction, and the special demand for shipping caused by the long series of wars which disturbed the commerce of every European nation, combined to assist the development of our maritime industries. Our ships began to contend for the carrying trade of the world, and our builders sought foreign markets to dispose of their vessels. The fact that most European powers forbade the naturalization of vessels built outside of their own dominions was then considered as a grievous restriction on our trade.

The increasing complexity of European quarrels produced attempts to restrict the commercial rights of neutral nations. The Milan Decree of Napoleon, the British Orders in Council, and the embargo imposed by our own government, successively harassed our mercantile marine. Our progress became slower, and in 1812 our registered tonnage amounted to 758,636 tons only. The persistence of Great Britain in her unjust claims in regard to the crews of our ships intensified the resentment caused by her jealous and selfish commercial policy.

The war of 1812 was undertaken to repel these assumptions and to insure the protection of our maritime interests.

The results of this war were, on the whole, highly favorable to our merchant marine. The capture of many of our merchantmen and the enforced idleness of the rest inflicted great losses on our shipowners, and rendered the war unpopular in the States most interested in shipping. But the demonstration of the superiority of our ships and our seamen over those of Great Britain aroused the pride of the nation, and secured the support of public opinion for the navy and the merchant marine. Though we were humiliated by the capture of our national capital, England sustained a greater loss when the prestige of her navy was lowered on the high seas.

The termination of this war brought a treaty by which our direct trade with Great Britain was established on principles of reciprocity, but restrictions were still imposed on our intercourse with her colonies, and retaliatory measures were still invoked to break down this regulation. But these were minor matters, and the era of liberal rules for commerce had begun.

With the treaty of 1817 a period of moderate but sustained prosperity began, which lasted about thirty years. In 1847 our register showed more than one million tons of shipping engaged in foreign trade. During the next ten years the rate of increase was wonderfully rapid. Two million tons of shipping were registered in 1854. During the four years ending June 30, 1856, the annual average of shipping built exceeded 500,000 tons. Of this vast increase, about 200,000 tons went to the foreign trade, as much more to the coasting trade, and a large proportion of the remainder was sold to foreign, chiefly British, buyers.

During these years the progress of American shipping was as sound as it was brilliant. We built more ships than any other people and we built the best ships. They were constantly employed in carrying the most valuable freights at the highest rates. They were preferred to the vessels of any other country by shippers of costly goods, and that preference was justified by the fact that they made quicker passages and delivered their goods in better condition than their rivals. They had exactly the same advantages over other vessels as freight carriers that steamers have over sailing vessels at the present day. All of these facts were shown by the evidence before the parliamentary committees appointed to enquire into the effects of the Navigation Act which began their work in 1847.

Among the details of this testimony we find that American ships brought all manufactured goods from England to the United States, while the best British ships had to carry salt and iron ; that they received higher rates of freight, were insured on better terms, and had the preference in every way. These advantages were alleged to be due to the greater intelligence, sobriety and efficiency of the masters and crews, to the better models and equipment of the ships, and to the greater economy at which these results were obtained. It was shown that the high wages paid in American vessels enabled the masters to select the very best seamen, and to carry a smaller number of them. The actual amount of wages paid was thus less in American than in British ships of the same tonnage, while the

former carried more sail, made quicker passages and earned higher freights. British shipowners talked of combination and patriotism as the causes of the favor enjoyed by American shipping, but the evidence shows that shippers of freight consulted their own interests then as they do now, and sent their freight by the quickest and safest vessels without regard to their nationality.

It is worthy of notice that this astonishing increase took place long after the practical success of steam navigation had been demonstrated. The Cunard steamers had been making regular trips since 1840. The mails, the cabin passengers and the transportation of specie and goods of great value were all transferred to the steamships, but they could not compete with sailing vessels for the carriage of the bulky staples of commerce. Our maritime supremacy was due to the superior advantages our vessels offered for such freights, and it terminated when these advantages ceased to exist.

Our merchant marine reached the culmination of its progress in 1856. In that year our ships carried three-fourths of our own exports and imports, and held the first place in the general carrying trade. It has been estimated that 1,500,000 tons, or more than one-half of our shipping, were employed in the ocean traffic of other countries. But the era of prosperity was about to close.

During the four years ending June 30, 1860, the annual average of shipping built was less than 250,000 tons, or less than half what it had been for the preceding four years. Our share of our own trade fell to 66 per cent. of the whole in 1860, from 75 per cent. in 1856. The sales of ships to foreigners and the rates of freight declined. Nor was this decadence confined to the United States.

Universal complaints were made that there was too much shipping in the world and that no profits were to be made. A long and careful investigation ordered about 1860 by the French government terminated its report in 1863, and declared that the merchant marine of France had failed to keep pace with the growth of commerce, and that the navigation of sailing ships had ceased to be a profitable and growing business.

The development of steam freight carriers had begun, and the superiority of iron as a shipbuilding material had been proved. The importance of these facts may be indicated here. Steamers average about three times the speed of sailing vessels on the high seas, but their greater despatch in and out of port and in discharging cargo increases their effective carrying power to five times that of sailing

vessels of the same tonnage. Steamers are also safer than sailing vessels on account of their speed and power of avoiding storms and dangers to navigation. Considering the percentage of wrecks for each class in connection with the number of voyages made, we find steamers are seven times safer than sailing vessels. The two qualities of speed and safety make steamers more efficient and also more economical as freight carriers. The use of iron instead of wood gives greater buoyancy, increased cargo space, finer lines and greater rigidity of the hull. The steamers are drier, safer and faster than when built of wood, far stronger in case of collision, and more durable in addition. The substitution of the screw-propeller for the paddle-wheel was also a step in advance.

All of these improvements, and the more recent modifications of steam navigation produced by the introduction of compound engines and steel hulls, have tended far more to reduce the cost of carrying freight than they have to increase the speed for mail purposes or the comfort of the passengers. The Persia, built in 1856, consumed thirty times as much coal per ton of freight carried as is required by the Arizona built in 1879. The progress made in this direction has increased the share of ocean freight carried by steam from 14 per cent. in 1850 to 61 per cent. in 1880. This percentage was more than doubled between 1850 and 1860, and this explains the beginning of the decadence of the sailing marine.

America was slow in beginning to build ocean steamers, slower still in adopting improved methods of construction and propulsion. The Collins line came into the field half a dozen years later than the Cunard line. Stimulated by national rivalry and a high subsidy, the American company built larger, faster and more sumptuous steamers than any owned by the competing lines. But they did not secure increased freight capacity or marine economy, and the series of accidents which ruined their fleet showed that the conditions of safety had also been neglected. Faster, safer, and more economical steamers were built. The Collins line failed to carry out the mail contract, lost its subsidy and abandoned the business in 1857. Neither our sailing clippers nor our wooden side-wheel steamers could profitably compete with the iron screw steamers of Great Britain, and we were not prepared to build the new type of ocean freight carriers. Although we had an aggregate of shipping equal to that of Great Britain on our registers in 1861, the period of decadence had begun. The decline of our merchant marine was

accelerated by the civil war of 1861–5. Shipping to the amount of 104,605 tons was destroyed by hostile cruisers, and 774,652 tons were sold to foreign flags. While those shipowners who received insurance, indemnity or purchase money for their vessels may be considered fortunate in withdrawing capital from a failing business, it is certain that great losses were sustained by the payment of war premiums on insurance and by the interruption of trade. Had the merchant marine been in a healthy condition it could have furnished the cruisers required to defend it from the Alabama and her consorts, and it would have recovered from the prostrating influences of war with the vigor shown by other industries which had been depressed. But this recovery has not occurred, and the decadence has been most marked in the most prosperous years of our commerce.

III.

The most humiliating chapter in the history of our merchant marine is that contained in the latest official returns—the report on commerce and navigation for the year ending June 30th, 1880. The total registered tonnage of the United States has declined from 2,302,190 tons in 1856 to 1,314,402 tons in 1880, a decrease of 42 per cent. The figures showing its employment indicate a more startling decline. In 1856 our shipping carried 75 per cent. of the total value of our exports and imports, in 1880 17.6 per cent. Our share of our own trade has fallen from three-fourths to one-sixth. The value of the goods transported to and from our own ports in American bottoms in 1880 was $280,005,497, while in 1856 it was $482,268,274. The decline in values seems to agree with the decline in tonnage, as we have 58 per cent. of each left. But the total amount of American shipping entered from abroad has remained about the same. The figures are 3,194,275 tons in 1856 and 3,128,374 in 1880. Apparently our remnant of shipping must be more actively employed now. But a glance at the business of our principal seaports will show that nearly two-thirds of this tonnage movement belongs to a mere supplementary coasting trade, the limits of which are the Gulf of St. Lawrence and the Caribbean Sea. Were Cuba and Canada annexed to the United States our foreign carrying trade would be trifling in amount. The value of goods moved for each ton of American shipping entered was $150 in 1856; in 1880 it had decreased to $90. The returns show that in the former year

American ships carried the most valuable goods shipped, while in 1880 their freights were much less valuable than those of foreign vessels. A comparison of freight earnings cannot be made, but it is known that while rates have everywhere fallen, the decline has been greater for sailing vessels than for steamers, and for wooden than for iron hulls. It is safe to say, therefore, that while we carry one-sixth of our own freight, our shipowners receive a much smaller percentage of the amount paid for its transportation.

When we examine the character of the vessels which make up our mercantile marine we find that we have only 146,604 tons of registered steamers, only 90,142 tons of which are of iron. The gain in steam tonnage has been very small during the last twenty years, and the aggregate of iron steam tonnage is too small to be encouraging. To replace the vessels wrecked or broken up we find that 157,410 tons of all classes were built in the year ending June 30th, 1880. About one-third of this tonnage was probably registered and about 10 per cent. of it was made up of iron steamers. This amount failed to maintain the figures of the preceding year. The decrease was 137,103 tons in twelve months. The amount of shipping built and the proportion of our own goods carried also decreased rapidly. The fall in the latter case was from 23 per cent. to 17.6 per cent.

Comparing this exhibit with the latest returns from Great Britain, we find that she has a total of 6,519,772 tons of shipping, excluding that of the colonies, and that she has 2,720,551 tons of sea-going steamers. Thus she has five times the ocean tonnage and nine times the carrying power that we have. She has twenty times the tonnage of steamers and thirty times that of iron steamers. She builds no wooden vessels, and only 57,534 tons of sailing ships to 346,361 tons of steamers in 1880. It is stated on good authority that 1,000,000 tons of shipping are now under construction in Great Britain, nearly all iron or steel steamers. The carrying capacity of British shipping steadily increases while ours declines. New methods and new materials are making rapid progress there, though we have adopted none of them. The British sailing tonnage employed in the foreign trade of New York is greater than the American, and ten times as many steamers are cleared under that flag as sail under our own. Two-thirds of our exports and imports navigate under the British flag. It must be noted that the increase in shipbuilding is confined to Great Britain, and that this industry languishes in her colonies, because they cannot build iron steamers, and not as the result of

taxation or other causes. The business of navigating ships is still more prosperous in the British colonies than in the United States, but it is carried on with vessels purchased in England in many cases. The maritime progress of other European nations is inferior to that of Great Britain; none of them have ever attained the position once held by this country, and none have fallen so low in the scale of progress as we now are. Every American who goes abroad notices with feelings of shame the disappearance of our flag from foreign waters. None see this more clearly or regret it more keenly than the naval officer. I have visited forty busy seaports without finding one American vessel, and the sight of one poor brigantine seized by a Spanish custom-house was not calculated to compensate me for a year's search for our national ensign.

I have visited an important port belonging to one of the great powers of Europe where none of the officials of the harbor could recognize the flag of the United States, never having seen it before.

It is necessary to add, that in my opinion the quality of our shipping has also declined. Our sailing vessels are equal to the best wooden ships of other nations, but they are at best awkward and obsolete tools for the prosecution of ocean trade. Our steamers are too often sent to sea worn-out and crippled. Such wrecks as that of the City of Vera Cruz are less strange than some of the escapes of the Ocean Queen and Rising Star on their voyages to Aspinwall. The sea-going steamers produced within the last few years show too many traces of the "steamboat" style of construction which exposes masses of joiner-work to the sweep of wind and sea. For this dangerous system the provision of law which exempts staterooms and cabins above the upper deck from tonnage measurement may be responsible. The latest improvements in marine construction are not in use in our navy-yards or private shipbuilding establishments. Naval vessels are destitute of the requirements of health and comfort, deficient in speed, and continually in need of repairs. Maritime taste and knowledge are dying out, and the approaching extinction of our merchant marine is regarded with general indifference. The causes of this unhappy condition of affairs deserve careful study.

IV.

By examining the conditions affecting the growth of our merchant marine we may select the effective causes of its decline. The high price of labor has always seemed to oppose the development of

our industries. Until our resources are fully utilized and our territories thickly settled, American workmen will always receive higher wages than those of other countries. This condition might be deemed fatal to our progress in the carrying trade when our ships compete directly with those of other countries where labor is cheap. But no industry specially favored by our position, resources, and the character of our people has failed to establish itself in spite of this apparent drawback. The mercantile marine entirely overcame this disadvantage during the first seventy years after our independence. The superior intelligence and industry of our shipwrights, combined with the cheapness and abundance of shipbuilding material, enabled us to build the best ships in the world at prices lower than inferior ones cost abroad. The same qualities in our seamen combined with the qualities of our ships to make them the most economical as well as the most efficient freight carriers in the world. Just as long as we gave our mechanics and our sailors the best materials and the best tools for performing their work of shipbuilding and freight carrying, they earned high wages for themselves and profits for their employers. It is true that the quality of our merchant seamen has deteriorated and that we now have only an inferior class of foreigners to man our ships. Were our merchant marine to enter upon a period of prosperity with first-class iron steamers, young Americans would gladly go to sea with some prospect of advancement, and the best foreign seamen could be selected where good fare and high wages were offered in fine ships.

The relation of wages to maritime progress is shown by comparing the merchant marine of the three countries which have been gaining most rapidly while our decline has been going on. These nations are Great Britain, Italy, and Norway. The increase in British shipping has been in iron steamers ; that of the others in sailing vessels. British seamen are better paid and better fed than those of any other country except the United States, while Italians and Norwegians stand at the other extreme. The success of steam freight carriers left to sailing ships only the slow and cheap freights and the very long voyages. This change destroyed the profits of expensively navigated ships like our own. They no longer could depend upon getting profitable cargoes, and they had to reduce rates to earn any freight at all. The cheap ships of Norway and Italy were able to bid lower, and the demand induced those countries to increase their fleets very rapidly. The Norwegians have as many ships engaged

in the trans-oceanic trade of New York as we have, and the Italians two-thirds as many. But they have learned that it is impossible for them to compete longer with steamers. The strenuous efforts of the Italian people and government to transform the obsolete mercantile fleet of wooden ships into an efficient one of iron steamers are well known, but their success is doubtful. From Norway our consul at Christiania reports as follows: "Norwegian shipping has yielded small profits for some years, and constant complaints are heard of sailing vessels being forced out of the market by the increased number of steamers everywhere."

The cause of this decline is evident when we learn that for each seaman of the British merchant marine 436 tons of freight are shipped annually, while for each Italian only 85 tons are moved. This result is partly due to the greater efficiency of the British seaman, but principally to the advantages of steam tonnage, which carries 75 per cent. of the freight in British bottoms and 25 per cent. in Italian. The effect of recent improvements in steam machinery and labor-saving appliances is shown by the decrease of the number of men employed in British steamers, from 4.67 per 100 tons registered in 1870 to 3.25 in 1880, a saving of 30 per cent. The Norwegians carry a little more freight per man than the Italians; they have better sailors but fewer steamers. An English shipowner can, therefore, spend four times as much per man for his crews as his Italian or Norwegian rival, and still have his work done cheaper. When our merchants send out the most approved and economical vessels they can afford to pay high wages; until then, they cannot. The high rate of wages did not hinder our merchant marine from growing up to 1856, and it has not injured that of Great Britain since then.

The high rate of interest prevailing here has also been brought forward as one of the obstacles preventing the advance of our merchant marine. When the government paid interest on its securities at rates equal to the profits of successful business there was some force in this statement; but when 4 per cent. bonds command a premium of 18 per cent. and the ordinary rates of interest are lower than they ever were before, this argument can no longer be sustained.

Without discussing the general policy of protection, its apparent influence upon maritime interests may be pointed out. A protective tariff checks the importation of foreign goods and lessens the purchasing power of foreign countries, thus unfavorably affecting the export trade. The effect on shipping is to compel them to trade

under the unfavorable condition of a full cargo in one direction only. The import trade of any country is largely controlled by its own merchants, and hence imports are more apt to be shipped in vessels of the country ordering them than in those of the country sending them. The articles which would be purchased by the United States under a tariff for revenue only would be valuable goods, paying high rates of freight, and they would be shipped in American bottoms were our shipowners able to offer equal advantages in speed, safety and cheapness. The manufactured goods which we now export are too small in bulk and value to furnish employment for many ships. They constitute only about 10 per cent. of the value and 2 per cent. of the bulk of our total exports.

The tariff of 1847 reduced the average duties collected on all dutiable goods from 44 per cent. during the ten years preceding, to 24 per cent. during the ten years following its passage. During the latter period our registered tonnage increased 240 per cent. The coincidence is striking. A further reduction in 1857 failed to arrest the decline then in progress, and the war tariff of 1861 soon followed, and, with all its anomalies, is still in force. The protective tariff may be considered as having contributed to the decline of our commerce in various ways, and the popular theory upon which such measures are founded is directly opposed to the increase of foreign commerce and the prosperity of the merchant marine.

Allusion has been made to the effects of the war on our shipping, and it is only necessary to point out that our share of our own trade fell from 66 per cent. for the year ending June 30, 1861, to 28 per cent. for the year ending June 30, 1865.

The taxes collected from our merchant marine are a real burden in its depressed condition. The sum realized by all the impositions sanctioned by Congress is not considerable as a part of the revenue, but it seriously oppresses nearly every person interested in shipping. The attempt is made to render all the official machinery, public safeguards, and charitable institutions established by law, self-supporting. Fees are paid to shipping commissioners, to consuls, to supervising inspectors and other officers for performing the duties of their positions, which are frequently made unnecessarily complicated and vexatious, and rarely benefit the persons who are required to pay the fees. The tonnage tax of 30 cents per ton is collected annually from all vessels, American or foreign, entering our ports from foreign countries. This tax does not materially affect the regular steamship

lines, but it may absorb a large part of the earnings of the poorer classes of sailing vessels. In measuring our ships for tonnage much space is included that is not counted in British vessels. This increased tonnage entails a corresponding increase in the tonnage tax, and in the light and harbor dues collected in foreign ports. The exaction of three months' extra pay for each seaman discharged by the consul's order in a foreign port is another grievance to shipowners.

The questions of local and State taxation, quarantine fees and compulsory pilotage need not be closely discussed here. The net income of the shipowner is all that is taxed in Great Britain, and all that should be taxed here, if our vessels are to compete with theirs. The pilotage collected at our principal seaports is an obstruction to their use by shipping. The generous wisdom which has lined our coasts with lights, buoys, and other sea-marks is defeated by the exaction of these exorbitant charges. The rates imposed at New York are as high as they should be were all aids to navigation removed and all charts destroyed. The fees for quarantine visits, fumigations, etc., are too numerous and too large.

The present burdens of taxation, which have grown with the decline of our maritime prosperity, are undoubtedly contributory causes of its complete prostration. The whole system should be swept away by the joint efforts of Congress and the State Legislatures.

The principal cause of the failure of our merchant marine to compete with that of other nations is, in my opinion, to be found in the fact that our shipowners are not allowed to purchase the best and cheapest ships to sail under the flag of the United States. There are three courses open to them ; they can buy good iron steamers by paying a great deal more for them than their rivals do for theirs ; they can continue to trade with obsolete wooden sailing vessels ; they can abandon maritime pursuits altogether. Statistics show that a few attempt the first course, that many cling to the second, that most accept the last. We built last year a few iron steamers and a considerable number of sailing vessels, but not nearly enough of either to take the place of the tonnage withdrawn from service.

It is frequently asserted that the difference in the cost of iron steamers here and in England is too small to exert any real influence on the progress of our shipping. It is claimed to be less than 10 per cent. higher here, but this assertion hardly seems credible. The prices of tonnage are regularly quoted in Liverpool, but there are no similar quotations here. In January, 1881, the prices were stated by

our consul at Liverpool to be as follows: for screw-steamers rated 100 A1 complete and ready for sea, $126.53 per registered ton for the finest passenger steamers, and $77.86 for plain cargo steamers.

Among the reasons for doubting the possibility of approaching these low rates, the large importation of iron and steel may be adduced. During the fiscal year ending June 30, 1880, these imports amounted in value to $45,466,986, and the enormous duty of 42.19 per cent. was paid on this valuation. The bulk of these products were not further advanced in manufacture than the plates and beams required for shipbuilding. While such duties can be collected, it is evident that iron ships must be more expensive here. This importation was even larger in 1881 than during the preceding year. The maintenance of the present tariff is insisted upon by all manufacturers of iron and steel, and their ruin predicted in case it is repealed. There are some who demand the advancement of rates upon certain kinds of steel specially suited to the purposes of shipbuilding. But even if all duties on shipbuilding material were removed, the freight and other charges would still make them more costly than in England, and ships would continue to be more expensive when built in the United States.

The price of tonnage has been an important factor in the progress of our merchant marine. During the period of its prosperity ships were always cheaper—quality and carrying capacity considered—than in any other country. In 1791 the relative cost of the best ships in France and America was stated as from $55 to $60 per ton there, and $33 to $35 here. The British parliamentary investigations held in 1833 and 1847 showed that a similar relation still prevailed. The evidence collected during the latter year showed the superior advantages enjoyed by the American shipowner, and led to the repeal of the Navigation Act and the admission of foreign-built vessels to the British register.

The fact that our merchants continue to build wooden sailing vessels instead of iron steamers shows that they cannot afford the more efficient vessels. British shipowners, untrammeled by restrictions imposed by law, build six times as many steamers as they do sailing ships, and our intelligent shipowners would not fall behind in the race could they be liberated from their burdens. Wood is still used as a material for river and coasting steamers in spite of the dangers incident to its employment. The use of iron or steel would give greater speed, lighter draught, greater capacity, and unsinkable

and fire-proof hulls that would rob collision of half its dangers. The extra cost must be the reason of this neglect of safety.

The only transatlantic line carrying the American flag has provided for its increasing business by chartering British steamers to make regular trips. These steamers pay the same tonnage tax, pilotage, etc., as the American-built steamers of the line, which are also exempt from local taxation, and the same classes of seamen are shipped for all the vessels. The legitimate prestige of the steamers under the national ensign must have attracted passenger traffic, but the line could not afford to maintain it by the purchase of American built steamers.

No attempt has yet been made to construct steel steamers in the United States, though the largest establishments of Great Britain are transforming their methods to make use of this material. The Naval Advisory Board of 1881 speak of "the certainty that steel is in the very near future to almost entirely supplant iron in the construction of vessels." The imperfect development of our shipbuilding industry, and the manufactures upon which it depends, is shown by their inaction in regard to the production and employment of steel plates.

The effect of increased first cost of vessels upon the profits of navigating them may be shown in the following manner: The life of a steamer being only twenty years, an annual deduction of 5 per cent. of her cost must be made from what is left of her earnings after expenses and the cost of repairs and insurance have been deducted, before any interest or profits can be reckoned. If the cost be increased 20 per cent. a deduction of 6 per cent. must be made; if it be 40 per cent. more, 7 per cent. of the same capital must be withdrawn before any gains can be made. Business must be very good to be profitable under the drawback imposed by the higher prices. The regular interest charge is also increased in the same proportion and a double burden thus imposed.

These considerations seem to justify the assertion that the high cost of efficient vessels is the chief among the effective causes which have depressed our maritime interests. This disadvantage is entirely due to the provisions of our statutes which forbid the grant of an American register to a vessel built outside of our territories. Scores of shipbuilders are ready to compete with each other for contracts to build any desired class of vessels at the lowest rates. The shipyards of the Clyde and Tyne are open to all the world, and resorted to by

all the world except the American purchaser.. There is no question of paying duties on ships bought abroad as on other manufactures which demand protection at home. For ships there is only absolute prohibition. The establishments protected by this prohibitory legislation are not half a dozen in number. Their growth is not large, their operations are not extensive, and their methods are not progressive. But the business of owning and navigating ships is sacrificed to their demands.

More than a century ago Burke said of the British Navigation Act: "If it be suffered to run the full length of its principle and is not changed and modified according to the change of times and the fluctuation of circumstances, it must do great mischief and frequently even defeat its own purpose." Has not this prohibition, the last effective survival of the principles of that act, reached the full limit of its usefulness?

V.

If it be admitted that the revival of our merchant marine would be a benefit to the nation, every artificial restraint and every obstacle created by legislation should be swept away.

The tonnage tax should be abolished, the fees to shipping commissioners for enlistments and discharges, the marine hospital tax, the fees paid by officers of steam vessels for certificates of competency, and the charges for registration and inspection of vessels should no longer be exacted. Supervising inspectors should no longer be allowed to impose useless and expensive patented devices for life-saving purposes on vessels inspected by them. This corps should be reformed, and its members should be required to show that they possess the "knowledge, skill, and experience in the uses of steam for navigation" which the law specifies as their qualifications. Should the present system of appointment fail to secure properly qualified men, there might be found officers of the navy specially fitted by education and experience for the work.

The whole system of public safeguards should be made as simple and as free from vexations as possible, and its expenses should be borne by general taxation and not by the industry to be regulated. The responsibility of owners and commanders of vessels should be strictly defined by law and enforced by the courts. No captain should be allowed to hold a certificate, and no owner should be permitted to earn profits, if found guilty of endangering life and property by reckless navigation or the use of unseaworthy ships.

Our consular service should undergo a thorough reform and its fees should be reduced or abolished. Appointments and promotions should be governed by rule, and not by caprice or political influence. Candidates should be subjected to a competitive examination before they are admitted to the service. Its standing and efficiency would be vastly improved were some knowledge of the forms of business, the principles of international and maritime law, modern languages and history required of each of our representatives abroad.

All of these reforms are within the powers of Congress, and it is believed that the questions of local taxation and compulsory pilotage of vessels engaged in foreign trade can also be regulated by that body. A register might be granted at the national capital, and local taxation thus avoided, as proposed by Senator Beck. The recent action of the legislatures of New York and Pennsylvania shows that the injustice and bad policy of crippling our merchant marine by local taxes is at last recognized. The removal of all such burdens is demanded by every one interested in shipping, but there are other measures of relief of equal or greater importance which have to contend with the active opposition of interested parties.

Congress passed an act in 1872 providing for the importation of shipbuilding materials free of duty, but a narrow construction of this law excludes iron and steel plates from the list, and thus prevents it from aiding the construction of iron steamers. This law should be amended to carry out the principle upon which it is based. Stores required for use on foreign voyages should also be allowed to be taken out of bond without payment of duty. No theory of revenue or protection should be allowed to stand in the way of such obviously necessary measures of relief for shipping. But such action will be only partially effective, and our shipowners will still be at a disadvantage in competing with foreigners.

They can be given equal facilities only by repealing the law prohibiting the grant of American registration to foreign-built ships. The tonnage markets of the world will then be open to them, and they can buy the most efficient instruments for the carrying trade as cheaply as their competitors. But this act of liberation is strenuously opposed, and the grounds of this opposition must be considered.

The arguments advanced by those most active in denouncing the free ship remedy are, in character and in manner, those of interested and therefore prejudiced persons. It is said that shipbuilding in the United States depends upon the maintenance of this prohibition for

its existence. The claims of this industry as a producer of wealth and a provision for defense should neither be neglected nor exaggerated. In both respects it is less important than the business of navigating ships. The freights earned by our feeble mercantile fleet engaged in foreign trade in one year are probably more than all our shipyards earn in five years by building vessels for that trade.

Were the nation to become involved in war, the possession of a respectable number of efficient steamers and the seamen required to man them would be a greater addition to the military power of the country than the possession of all the private shipyards fostered by present legislation. When it is proposed that this system be retained without change, the question arises how long the greater industry is to be sacrificed to the requirements of the lesser one.

We have a right to anticipate that the business of building ships will, in time, be promoted by establishing the practicability of owning and sailing them profitably. With foreign competition will come increased inventive activity, and new motive-machinery and systems of construction may restore all the advantages we have lost by their adoption abroad in the past. With the natural advantages we enjoy, the time may soon come when our shipbuilders will be willing to compete with the world in turning out first-class vessels at moderate prices. When the British Navigation Act was repealed in 1849 our shipbuilders were the best in the world, but within a few years a new material and a new type of vessels were created which transformed the conditions of maritime progress. Changes equally great may occur in the near future. The discovery of some quality of steel exactly suited for shipbuilding which could be produced rapidly at a low price, or the invention of a safe and economical method of using petroleum as a fuel, or electricity as a motive power, might effect another revolution. In the meantime our shipbuilders could earn as much by repairing the ships of a merchant marine proportioned to our needs, as they now earn by building the few ships which our merchants can afford to buy.

The great bulwark of protection is invoked to shelter the shipbuilding industry as it does so many others. But there is a great difference between levying duties on an article and prohibiting its entrance. In one case the government makes a revenue, and the consumer has his goods if he can pay the increased cost. In the other the government receives nothing, and the shipowner abandons his trade for want of efficient instruments. The protective tariff is

supposed to give our manufacturers an advantage over their foreign rivals by shutting out direct competition. The shipowner cannot be protected from competition, and he is placed at a ruinous disadvantage with his foreign competitors by our navigation laws. The shipbuilder is apparently protected at the expense of the shipowner, but the prosperity of his trade is really dependent upon that of the merchant marine, and neither of them has shown any healthy growth for many years.

To secure popular favor the assertion is made that the present standard of wages for mechanics required in building ships and seamen employed in sailing them can only be maintained by adhering to the present system. The repairs of the shipping employed in carrying one-half of our ocean freights would amount to more and employ a larger number of shipwrights than the building of new tonnage does now. The wages of seamen would tend to rise with any increase in the number of ships. The number of men trained to the sea must be compared with the total amount to be expended for wages. The revival of the merchant marine would increase this sum and elevate wages until the demand for seamen was fully supplied.

It is also charged that our merchants would buy unseaworthy ships if foreign markets were open to them. There is no reason to believe that the majority of our shipowners are so destitute of business capacity as this charge implies. If they are, a certain classification at Lloyds or some other reliable standard, and a rigid inspection of all vessels purchased abroad, might be required to protect the public interests. Great Britain builds more steamers than the rest of the world combined, and the skill and experience thus acquired, the natural effects of competition on a large scale, and the vigilant inspection exercised by the government and the underwriters, have made those vessels the best in the world. Until we are prepared to build as well and as cheaply, our shipowners should be allowed to go there to buy.

We are told that it would be a humiliating spectacle to see the American ensign flying on board a vessel built abroad. There is more humiliation in seeing that ensign disappearing from the highways of commerce or shown only by inferior and obsolete ships. It is said that resorting to England to buy ships would place us in a position of dependence upon that country. It may be pointed out that we are now completely dependent upon that power for the ton-

nage required to export our surplus productions and to return the foreign goods demanded here. Our freights, our mails, and our passengers now cross the ocean under the British flag. The purchase of steamers might restore some portion of this traffic to the American flag, and secure us from its interruption should England become involved in war. It would, therefore, tend to relieve us from such dependence. The scruples of false pride and the fear of so-called dependence have not prevented the great powers of Europe from buying men-of-war, yachts and mail-steamers from British builders. Those who have seen the magnificent vessels of the North German Lloyds and the French Transatlantic Company would hardly feel that our flag would be disgraced were similar fleets sailing under it. Wherever subsidies and bounties are paid for the navigation of steamers, British-built vessels come in for a share.

In making appeals for the maintenance of the present prohibition of the purchase of foreign-built ships for the protection of the few shipbuilding establishments we now own, it is gravely stated that these concerns have claims on the country because they have gone on supporting workmen and their families for years, simply to promote the welfare of the nation and the interests of labor. Those who can believe that capital is invested in business schemes with any higher motives than a creditable desire to make money may attach some importance to such claims.

The culminating charge against advocates of free ships is that they are theorists and inspired by British gold. It is worth while to follow the recent course of the agitation of this question, to investigate the probability of such statements as the following, which I find in a serious and well-written work on the subject of shipping. It is to the effect that "this agitation is the result of British cupidity and conspiracy, stimulated by business depression and idle ships." The veteran shipowner, Captain Codman, opened the discussion in 1857, and has kept it alive ever since. During the war all such questions were neglected, but soon after its close the decline of our shipping attracted the attention of business men. Among the organizations which have taken action upon the subject is the National Board of Trade, composed of delegates representing commercial interests in every part of the country. In 1868, 1870, 1871, 1873 and 1877, the repeal of that clause of our navigation laws which prohibits the registration of vessels foreign-built was supported by two-thirds of the delegates, and a similar resolution presented in 1879 received the votes of a majority.

The report of the executive council of this body for 1880 contains a complete summing-up of the case in which this measure is advocated with clearness and force. The same action was recommended to Congress in a special message from President Grant in 1870. This policy has the support of the leading journals of all parties in the commercial capital of the country, and has the endorsement of practical men and students of economical sciences everywhere.

This position does not rest upon novel theories or those of foreign schools. The question was debated long ago, and I find the following argument extracted from an American periodical published in 1791. Speaking of a report that France had decided to allow her merchants to buy American ships, which were then the best and cheapest in the world, he says: "If France had rejected American vessels, she would have so far sacrificed her carrying trade to the manufacture of ships. She wisely purchases, upon the cheapest terms, the cradles for her marine nursery. The first and great object of the maritime powers ought to be the increase of the number of their sailors, which is best done by multiplying the chances of their employment." After stating the prices of tonnage in the two countries as 60 per cent. higher in France than in America, he goes on to say: "No argument is necessary to show that such a nation, *cæteris paribus*, must produce seamen more rapidly than those who refuse these cheap vessels. It would appear much less unreasonable that the government of the United States should prohibit the sale of ships (the means of obtaining naval strength) to foreign nations, than that any of them should reject the advantages of so cheap and excellent a supply." If the names are changed to suit the present conditions, this argument will have the force of a demonstration, although it was published in Philadelphia before that city became the chosen seat of political economy and iron shipbuilding.

VI.

The means here proposed for the revival of our merchant marine are general measures of relief and liberation. The most important features of this plan are the repeal of duties on shipbuilding materials, and the removal of the restriction which prevents our merchants from buying ships abroad, and both these measures are vigorously opposed by powerful advocates of another policy. This alternative policy may be described as one of restrictions and subsidies. Re-

strictions are demanded to drive foreign ships from our trade, and subsidies are implored to build up a fleet of American ships to take their places.

The favorite forms of restriction include the imposition of heavy discriminating duties upon foreign bottoms and upon goods imported by them, and the enforcement of the direct trade rule requiring goods to be imported in American ships, or in ships of the countries in which they are produced. The advocates of this policy demand the abrogation of the treaties which bind us to a more liberal policy, and demand the strict enforcement of those provisions of our navigation laws which have been suspended by reciprocal agreements. The arguments used in support of this proposal to abandon the system under which our commercial development has taken place, and to return to the policy of the middle ages, are based upon certain versions of history which require examination.

The British Navigation Act is the foundation of the system to which we are invited to resort. That act was passed in the time of Cromwell as a hostile measure against the Dutch, who had acquired the leading place in the carrying trade. That place was lost as the result of a combination of causes, among which the provisions of this act may have had some effect. Its immediate success as a means of making England a great naval power was not brilliant, as we read of Dutch ships, partly manned by English seamen, sailing up the Thames and threatening London within a few years after its passage. In time, however, the power of Holland declined, and England acquired that supremacy in maritime affairs which she still enjoys, and which has never been threatened except by the progress of the United States. The efforts made by the American and English statesmen to secure the establishment of a liberal system of reciprocity between the two countries failed, and our legislators reluctantly adopted the principles of the Act of Navigation as the foundation of their retaliatory legislation.

But the hostile provisions of the laws of both countries were never strictly enforced, they were gradually abrogated by the adoption of new treaties, and the growing commerce of the two nations was thus allowed room to expand. The maritime activity shown in this country alarmed the interested classes of Great Britain. Parliamentary investigations were held in 1833 and in 1847, and both of them established the fact that the merchant marine of Great Britain had failed to compete successfully with that of the United States. The

causes of this failure were found by the committee of 1847 to be the enforcement of the surviving provisions of the Navigation Act. The effective clauses then existing were those applying the direct trade rule to certain imports, and the refusal of a British register to foreign-built ships. In the face of the evidence collected it was felt to be ruinous to maintain these provisions, and in 1849 the whole fabric of the restrictive maritime policy was swept away. This was done when the United States was the greatest shipbuilding and navigating country in the world, and the opponents of the measure, led by the late Earl of Beaconsfield, loudly proclaimed the ruin of British shipping and of British shipbuilding. The success of iron steamers as ocean freight carriers had not been proved, and no evidence bearing upon their capabilities was sought. The years immediately following were those of the most rapid development of our merchant marine. English merchants employed our ships gladly, and bought many of them to sail under their own flag, while their shipbuilders worked out the problems of new material and new means of propulsion, and in less than seven years produced the iron steam carrier of ocean freights which has re-established the supremacy of the British merchant marine.

The abrogation of our treaties with all civilized nations and the destruction of the enlightened system of reciprocity which we were the first to introduce into the international code of Europe, would be attended by many difficulties and would entail the loss of cordiality and commercial relations with many countries. But, even if these practical difficulties were overcome and the change effected without any sacrifice of the national honor, the desired result would not be secured.

The direct trade rule is the favorite device for substituting American for foreign ships in the movement of our own commerce. Its effect may be estimated when we see that 55 per cent. of our trade is carried on with Great Britain and 25 per cent. with other European countries, all of which are better prepared to transport the goods than we are. This leaves only 20 per cent. of our trade to be carried on with countries imperfectly supplied with shipping. If our vessels took the whole of this, their share would only be increased from 17.6 to 20 per cent., which is a trifling gain. But they would get only a small part of it. China and Japan are quite ready to buy English steamers whenever they can find employment for them, and such a measure would afford them a long-sought opportunity. The result of

the adoption of this rule would probably be to confine our shipping to the West Indian and Mexican traffic which now forms their principal resource.

The adoption of a system of hostile discriminations would greatly diminish the total amount of our commercial transactions with foreign countries. Vessels would be deterred from seeking our exports when they could no longer land imports. Freight tariffs would be raised, and the increased cost of imported goods would be borne by the American consumer. At the same time the exports would decrease in quantity and the surplus products of the country would be almost worthless. The President of the New York Produce Exchange stated in October, 1880, "that the difference of one penny in the cost of laying down grain at Liverpool may determine the question whether millions of bushels shall be supplied from this country or shall be drawn from the ample fields of Hungary or Southern Russia."

It must also be remembered that our shipping can be excluded from employment in the trade with any foreign country by the application of the system which it is proposed to inaugurate in our own ports. The simplest measures of retaliation will entirely defeat the object of such action. The principle declared by Jefferson in the last century is one that will always be obvious to foreign legislators. In a report made to Congress he said, "Free commerce and navigation are not to be given in exchange for restrictions and vexations." Common sense forbids us to disregard this maxim.

We next come to the plan of encouraging steam navigation and building up a merchant marine by the payment of subsidies. It is frequently asserted that the payments so persistently demanded are not properly called subsidies, but are only a fair compensation for services rendered in carrying the mails. It is assumed, however, that liberal appropriations of public money are all that is needed to promote the building of American steamers. No one will object to our postal authorities showing a natural preference for American steamers in making mail contracts. If there is any important mail-route over which communications are not properly maintained it is their duty to establish them and to expend the sums necessary for the purpose. Nor should they be limited to the ocean postage on the matter transported. But the end sought is to replace the foreign steam lines, now carrying the mails, by American lines dependent upon mail-pay for their support. In making contracts for this purpose the

value of the service performed and the rate at which it can be secured in open market are to be disregarded, and the demands of American shipowners are to be satisfied and their profits assured by the government. No limit to the amount to be appropriated is assigned by the advocates of this scheme, and no estimate can be made here. An attempt may be made to give an approximation to the sum required to secure the necessary facilities for carrying our mails to Europe. Nine weekly mails are now dispatched from New York by as many different steamship lines. More than forty first-class, full-powered steamers are required to make the regular trips on these lines. From the demands made heretofore the sum of $3,000,000 would have to be paid annually to secure a similar service by American steamers. The cost of this service is now only $150,000 annually, and the steamers carrying the mails do not complain of the present rates. An attempt to divide the service between our own lines subsidized according to the proposed rates, and foreign lines paid at the rates of ocean postage now allowed, would hardly be successful. If an American company gets $300,000 a year for dispatching a mail steamer every Tuesday, a foreign one will hardly accept $15,000 for sending out every Thursday an equally powerful vessel.

The result of an attempt to supplant foreign steam lines as mail carriers by subsidizing our own would, therefore, tend to multiply the cost of the service and to diminish its efficiency. The proposed scheme for establishing a line of steamers to cross the Atlantic in five or six days, carrying mails and passengers only, will not deserve encouragement involving the expenditure of public funds. The success of a small number of vessels in this enterprise would confer no great benefit upon the mail service, as the frequency with which mails can be dispatched is, in these days of ocean telegraphs, more important than a slight gain in speed. The creation of a large fleet of steamers so extravagant in first cost and running expenses would require an immense appropriation, which could not be called anything else than a subsidy.

It is the duty of legislators, before inaugurating a subsidizing policy for our merchant marine, to count the cost of such action. The cost of transporting the mails sent out from the New York postoffice to steamers built in this country would be at least $3,000,000 annually, or twenty times the sum now paid for this service. But New York is only one of a dozen ports which will demand subsidies if this system is adopted. The claims of other localities, backed by legislative

votes, will secure a division of the spoils. The wholesale grabbing of the Rivers and Harbors Appropriation Bill will be repeated. If the measure be made general and the subsidy be paid in the form of mileage, its benefits will be claimed for all classes of vessels. The owners and builders of sailing ships will insist upon sharing the public bounty, and they have advocates not less eloquent than those of iron steamers. The cheapest and least efficient classes of vessels will make the most profit from this form of aid. If the act is made special, designating specified routes and describing the vessels to be employed, the contracts will fall to some of the very small number of men now ready to buy or build such vessels, and the rest of the merchant marine will be further depressed by the favor shown to them. If the legislation which has prostrated American shipping is maintained, and persons are induced to embark capital in that business by the implied promises of the Government to guarantee their profits, the business will never adjust itself to economical conditions, but will become an increasing burden upon the country as long as this scheme is pursued.

The American people have learned to dread the enactment of any subsidizing measure. The national treasury has been plundered, officials and legislators have been corrupted, and commercial enterprises shipwrecked by the success of every such measure. Their impolicy is no less evident than their injustice. The scandalous record of the Pacific Mail subsidy has not been forgotten. The increase of its subsidy was procured by bribery, and the sums received were never legitimately employed in renewing its fleet or increasing its business. The speculators who acquired control of the company made it a means of gambling. They lost its steamers, sacrificed its business, cut down the salaries of its most efficient servants, and brought disgrace and ruin everywhere. The unsavory memory of these transactions will baffle the advocates of like schemes for a long time.

No other line which has been promoted by subsidies has attained any lasting success. The simple fact that the Collins line to Liverpool, those running to Havre and Bremen, and both of the lines to Brazil, have failed to establish themselves by such means has great significance. They failed while our commerce on the high seas was rapidly increasing. They were beaten by non-subsidized foreign lines, navigated according to business principles. The subsidy received by the Collins line was higher in proportion to the service

performed than that paid to any of its competitors. This subsidy was not withdrawn until the mail contract had been repeatedly violated. The managers of the line had staked its success upon the maintenance of the subsidy. Its steamers cost too much to build and repair and were too expensively navigated to earn legitimate profits. The Garrison line to Brazil received $150,000 annually for ten years for running its inferior wooden steamers, and withdrew them, worn-out and worthless, as soon as the contract expired. When steamship lines are made dependent on Congressional action, the uncertainty of their position promotes speculation and discourages solid improvement.

Some of the arguments used in favor of subsidies twenty-five years ago have a certain historical interest now. It was gravely proposed to develop the subsidy system until all foreign steamers were excluded from our coasts and their captains prevented from learning the soundings and approaches to our ports. The senator who advanced this argument must have been ignorant of the labors of the Coast Survey. But the reliance of all advocates of subsidizing measures was the calculation by which it was proved that ocean freight could never pay the cost of steam transportation. Volumes were written to prove the truth of this statement, and it was supported by the science and practical knowledge of the country. Now that it has been overthrown by the facts of progress, the need of a subsidy can no longer be claimed on commercial grounds. Those who foresaw the success of steam freight carriers demanded that the conditions of speed should be fixed so high that only those vessels which carried no heavy goods could compete. The valuable part of the trade was to be sacrificed to gratify our national vanity in the speed of our steamers.

We are told, however, that we must learn from our rivals, that England has built up her steam marine by the payment of subsidies, and that we have failed only from lack of persistent liberality. When it is seen that Great Britain pays over $3,000,000 annually for the carriage of ocean mails, that less than one-half of this sum is returned in postage receipts, and that this subsidy has been much larger in the past, this reasoning seems plausible. It is evident that some other purpose than that of offering facilities for the transmission of private correspondence has affected the policy of Great Britain in regard to steamship subsidies. The secret of her policy and its influence on her shipping may be disclosed by examining her situation and interests.

England is dependent upon her commerce for her existence, and upon her colonies for her position as one of the great powers of the civilized world. To secure those possessions her army is scattered over the world, and her navy is compelled to maintain the first place among similar establishments.

By no other means can the control of the British government over all these widely scattered interests be so readily and cheaply maintained as by the transmission of regular and rapid mails. The expenses and humiliations of the late wars in Afghanistan and South Africa might have been spared, and a longer lease of power have been granted to the late Conservative ministry, had they been able to regulate the action of distant and over-zealous subordinates in accordance with the public opinion of England.

The early contracts for carrying the mails by steam show the force of these considerations. Cunard was compelled to modify his plan of running his steamers to Boston and New York. The government insisted upon making Halifax the terminus of their mail route. The needs of commerce, the conditions of navigation, and the competition of American clippers were all neglected to secure close communication with the colonies. The contract with the Peninsular and Oriental Company was also burdened with onerous conditions. The route required for mail transportation was a difficult and uncommercial one, a double force of steamers being required and no freight traffic possible. These steamers relieved men-of-war from the duty of carrying the mails, and the change greatly reduced the cost of this service. The Royal Mail line to the West Indies was the next important line to be established, and it was compelled to send steamers to many ports and islands destitute of trade and difficult of access. The contracts with these lines were made when the practicability of making long ocean voyages with regularity and safety was doubtful, when speed was costly, and freight-carrying on a large scale impossible. The subsidies were liberal and probably rendered some aid in the experimental stages of steam navigation. These three companies have had their contracts renewed from time to time, and, though the subsidies have been greatly reduced, they still receive the larger part of the total sum expended by the British postoffice for ocean mails. The Cunard line has submitted to very great reductions, and has voluntarily shared the contract with rival companies for many years. During the early years of its business as much as $800,000 subsidy was received, but the high rates of postage

then collected are said to have brought a handsome profit to the British exchequer. The mails to India and China are the most unremunerative of all, but even there the reductions have been large and the requirements of speed have been increased and enforced by heavy penalties, so that the subsidy still has a close relation to the actual cost of the service. The mails from Brindisi to Bombay are still carried by steamers which do not avail themselves of the Suez canal, but forward mails and passengers through Egypt by rail, to escape the penalty of $500 imposed for each twelve hours' delay. The average reduction on all contracts renewed within the last few years has been 36 per cent., and the total loss to the government on contracts for mails to foreign countries is now about $600,000 annually.

Whatever effect the mail subsidies may have had thirty years ago in developing the ocean steamer, and whatever importance they may still have over routes not available for commercial navigation, it is certain that the present superiority of the steam merchant marine cannot be attributed to them. The total mail-pay amounts to about 1¼ per cent. of the freight money earned by British shipping, and the latter source of revenue increases constantly while the former diminishes. There are about 450 British steamers engaged in the trade of New York, of which not one in ten receives any mail pay. The aggregate sum paid for this mail service is about $270,000 annually, which would average about $600 for each steamer, or about $6000 annually for each of those which carry the mails. Their total freight and passenger earnings are probably forty times as much. The success of such magnificent non-subsidized lines as those of the Pacific Steam Navigation Company, the Liverpool, Brazil and River Plate Company, and many of the lines running to New York, shows that success is possible without government aid. Wherever there is an important highway of commerce we find independent lines competing successfully with subsidized ones, and lines which receive subsidies often increase their trade by employing other steamers which do not receive any.

None of the nations of Europe have ever been able to compete with Great Britain in the carrying trade, though many of them have subsidized their steamers more liberally. In France and in Italy, and everywhere that a subsidizing policy has been adopted, the decadence of the merchant marine is announced, and higher subsidies and more protection are demanded. Though labor and living

are cheaper in every country on the continent of Europe than they are in England, they cannot compete with her in building and navigating ships. France has the second-best steam merchant marine in the world, but she has admitted her failure in the race by adopting a system of bounties on vessels and machinery and subsidies on mileage for all French vessels. The provisions of the latter clause apply to vessels built out of the country, though there is a slight discrimination in favor of those built in France. English economists anticipate that the increased demand for tonnage will help their shipbuilders quite as much as their shipowners will be injured by the measure.

The influence of subsidies upon those vessels which do not receive such aid must also be examined. The building of sailing ships and their employment in our commerce can no longer be considered beneficial to the interests of the country. They are inefficient instruments for the carrying trade, and cannot earn enough freight to make them profitable investments or liberal employers of American seamen. To expend public money in promoting such an industry would be injurious and wasteful. But these vessels have deserved well of the country for their past services, and their prospects of earning some return for the capital invested in them should not be destroyed by artificial competition. The representatives of this interest will insist that the aid given to steamers shall not be withheld from sailing vessels, and if they fail in this they will demand that such regulations in regard to size, speed, etc., shall be imposed upon steamers as shall prevent them from competing for the transportation of cheap freights. The iron freight steamer for the general carrying trade will, therefore, be excluded from our steam merchant marine. This type of vessels are not elaborately finished, do not possess great speed, are not adapted for mails and passengers, and have none of the qualities for which subsidies are proposed to be paid. They are constructed to secure the greatest cargo space with the lowest rate of coal consumption. They are strong enough and fast enough to serve as transports or blockaders, and their lack of passenger fittings leaves them in a condition to be made promptly available for war purposes. Their convenience and economy render them the most popular class of vessels for the carrying trade. The greater part of the steam tonnage now building in England is in this class. But the creation of such a commercial fleet will not be prevented by the passage of any of the subsidizing measures now before the public. The

freight traffic of the world is capable of indefinite expansion, but these schemes neglect it, and base all their claims upon the mail and passenger traffic, which do not increase so rapidly, and which can never maintain a merchant marine proportionate to the greatness of the country. The conditions of success in freight carrying are economy in first cost and running expenses, and efficiency and adaptability to the trade of different ports and different staples of commerce. The steamers described in the proposals for subsidy appropriations are required to be of American construction, of more than 3000 tons in size, and capable of a speed of more than 15 knots per hour. Such vessels satisfy none of the conditions of commercial success as freight carriers, and must be dependent upon subsidies for support, except on those routes where they can secure many valuable freights and a large passenger business. The freights of the world will soon be transported by a special type of steamer evolved by the process of trade competition. No legislation can prevent this development, and the measures under discussion would exclude our vessels from any share in its certain gains.

VII.

The defensive importance of an efficient merchant marine has been pointed out, but the discussion of the means to be taken for its promotion has been postponed, because it is essential that it should not be confounded with the economical and commercial considerations already detailed. The value of our merchant marine as a means of defense is increased by anything which insures its healthy growth as a profitable industry. But there are certain directions in which that growth may be assisted with advantage to our naval preparation for war. It is evident that such preparation is the duty of the general government, and its cost is chargeable to the general revenue. It should not be borne by the maritime interests alone. Moreover, the application of public funds to distinct purposes of this kind can be effectually controlled by Congress, while any attempt to reverse the conditions of maritime progress by general appropriations involves the unchecked expenditure of immense sums which cannot be computed beforehand.

The training of seamen is the most important work of the merchant marine considered as auxiliary to the navy. The boys turned out by the present system of training-ships will be valuable to the nation as

a naval reserve just as long as they continue to follow the sea. The graduates of the training system might be encouraged to join the merchant marine by the hope of advancing to responsible and well-paid positions, if it were prosperous and growing. Some allowances might be paid to retain their connection with the naval service. Such payments should depend upon their continuing to go to sea and to keep up their nautical skill and knowledge. Regular inspections might be held at which all members of such a reserve should report, and short courses of drill and instruction might be made a part of the system. Of course they must be fed and paid while so engaged, but the offer of gratuitous instruction in navigation, steam-engineering, and other branches of knowledge which might aid them in advancing themselves in maritime pursuits, would attract the more intelligent members of such an organization. Those who acquired a certain proficiency in such subjects might receive certificates, and if any of them were afterwards promoted to positions of trust, their progress might be recognized by the assignment of honorary rank in the naval reserve proportionate to their length of service in places of responsibility. The benefits of this system might be extended to men of good character in the naval service, and to any Americans possessing a certain amount of education and nautical skill. A prosperous merchant marine could maintain a naval reserve equal in numbers and not greatly inferior in efficiency to the present naval force of the country, and the expense would be comparatively small. The present condition of the merchant marine will repel all sober and intelligent young Americans who might otherwise go to sea. If that condition is altered for the better and some additional inducements offered, there are many who might find employment there.

The merchant marine is also a reserve of ships and dockyards which may supplement the resources of the navy in time of war. During the civil war these resources were severely tested, and the result showed the weakness of our material reserve. Of all the steamers purchased by the government, it would be hard to name one that proved itself an efficient and economical cruiser or blockader. Our commerce suffered from the depredations of cruisers which could have been destroyed by any one of the better class of freight steamers which may be seen by scores in our ports, were a proper armament furnished. When we come to the constructive capacity of our shipyards and machine-shops, the failure is not less marked. While two-thirds of the tonnage and nine-tenths of the engines built were

the work of private yards, no proper return for the money expended was realized by their use. The brilliant inventive talent displayed was not seconded by adequate scientific knowledge or mechanical skill. Our best monitors even have never been more than crude experiments, and at present they are all better suited for historical monuments than for weapons of warfare. The materials employed in building our ships and supplying defensive armor were defective, and the methods of construction wasteful and untrustworthy.

The failure of the contract system to secure good designs and honest workmanship, and the enormous losses thereby entailed, have disposed many naval officers to question the possibility of securing good results by its use. In case of war it must, however, be resorted to, and it is best to test its working in times of peace. A special corps of inspecting officers might be selected from the officers of the navy, by means of an extended competitive examination on the proper technical and scientific subjects. Such a body of men, practically acquainted with the management of ships and engines, provided with proper testing machinery, and experienced in the performance of their special duties, could be relied upon to inspect any work done by contract. A considerable amount of sea service should be required as a qualification for candidates for these positions, and by allowing those selected the sea-pay of their grades, they would be enabled to perform these responsible duties without entailing any great expense to the government. To a board made up of such officers, all new maritime inventions and appliances should be referred for examination. No such devices should be purchased by the government until they have been thoroughly tested by such a body. Standard tests for iron and steel plates and bars, chain cables, etc., should be devised, and manufacturers should be encouraged to have their products tested and their quality certified. Even food preparations might be inspected, and reports of their keeping qualities and fitness for use in sea-going vessels might be made. Improved methods of packing and preserving our food products will not only greatly promote the health and efficiency of the crews of our men-of-war and merchant vessels, but will also increase our export trade more certainly and more profitably than any other industry can be expected to do. The market for honest and attractive goods of this kind is practically unlimited, and a guarantee of their soundness and freedom from adulterations would secure our best goods an immense sale.

The amount of shipping required to maintain a decent semblance of a navy will compel the building of at least 100,000 tons during the next eight years. As our naval constructors have no experience in the construction of iron or steel vessels, and our navy-yards are unprepared to do the work, it would seem that such vessels should be constructed in private yards. The interests of the government might be guarded by rigid specifications, the employment of qualified inspectors, and the enactment of a law forbidding the payment of any sum appropriated for the building of these vessels until they have satisfied certain conditions in regard to speed, displacement, etc., which form the basis of each contract. It might be well to invite the best designs for improved vessels by the offer of a liberal reward for each of the various types required. This competition should be open to the world, and the prizes should be large enough to secure the best talent. In no case should any of them be paid for any design not possessing great merit, and the whole sum should not be handed over until a vessel has been completed fulfilling the specified conditions. The immediate construction of such a fleet in our private shipyards would insure them more employment than they have been able to get under the present policy of protecting their business at the expense of the carrying trade.

A special class of merchant steamers, adapted to increase the naval force in case of war, should also be constructed under similar supervision. The qualities of a transport, a blockader, or an ocean cruiser could be secured without depriving vessels of the economical character required for freight purposes. Speed and handiness, with the necessary strength of hulls and machinery, would be the main conditions. Some extra cost would be entailed by the additional compartments, extra strength of decks and bows for ramming, and the arrangement of engines and boilers for protection by coal or water. This addition to the cost should be carefully ascertained, and should be borne by the government under a contract which should provide for the employment of these vessels during war at a moderate rate of compensation to the owners. Representatives of our nautical and commercial interests should be appointed to assist in preparing the specifications under which designers should be invited to compete. In this work and in the subsequent selection and carrying out of plans, the inspection corps of the navy should be employed. The designs should include the special fittings necessary to prepare the vessels for war or for the transportation of special classes of

freight, such as live animals, perishable goods, etc. The naval arsenals should provide all the details belonging to the fighting outfit, and they should be made to correspond to this type of vessels and tested on board exemplars to be built and retained by the government. Were good designs procured and economical construction secured by the repetition of the type, merchants would be enabled to secure vessels of a class suitable for the general carrying trade, and the extra strength paid for by the government would increase their safety and durability without entailing higher cost to their employers. A careful and deliberate resort to this plan of securing a naval reserve of ships would enlarge the defensive power of the nation, and would be safer and less demoralizing than the lavish general appropriation so often demanded. The creation of such a reserve force is simply an economical means of building up our navy.

VIII.

In the preceding pages I have pointed out the measures best calculated, in my opinion, to promote the revival of our merchant marine, and I have attempted the discussion of some of the schemes presented by those who differ with me. I believe that measures of liberation, including the removal of taxation and the opening of the tonnage markets of the world to our merchants, are those best adapted to promote a healthy and natural growth of our maritime industries. But that increase must be slow, and the present depression is so great that it may require a whole generation to give our merchant marine a respectable standing. Some great expansion of commercial operations is needed to give room for more rapid development.

There are two measures which will tend to produce a movement specially favorable to the carrying trade and to the merchant marine of the United States. It is within the power of our government to make them effective within a few years.

The first measure is the prompt completion of the Panama canal. I say the Panama canal, because that is the only one which proposes to provide the conditions required by steam navigation. It has been argued that we should build a canal with locks to put sailing vessels nearer to an equality with steamers. But no such action can reverse the judgment of the age in favor of steam for all purposes of navigation. The success of a canal adapted to the use of steam vessels

will give immense increase to their employment. If we are ready we shall have every advantage in competing for this trade; otherwise, it will be done under the British flag. The opposition of those interested in sailing ships or Pacific Railway stock should not be allowed to affect the national policy. The coasting trade between our Atlantic and Pacific ports would be rapidly increased by this change of route, and all its advantages would be felt most directly by the commerce of this country. Among the benefits of such a change would be that of compelling the Pacific railroad companies to apply themselves to their proper work of assisting the development of the interior of the country, and to abandon the policy of discriminating against the very sections which should furnish them with freights. The insolent and oppressive action of this monopoly in combining to extort high rates of freight and high prices for necessaries of life from those people who have no other means of communication, is well known. We see great prominence given the fact that this line carries tea overland, but the fact that they have imposed a prohibitory rate on sugar to aid the extortions of speculators in California is not less significant. The difficulties encountered by the government in collecting its claims against these companies and their general overbearing policy are not likely to encourage the extensive application of the national revenue to the purpose of subsidizing private interests.

The other and more important means of promoting our commercial activity and reviving our merchant marine is the liberal revision of our present tariff. Our import trade would greatly assist our exporting power, and the whole effect would be favorable to the employment of American shipping. If proper discrimination were used and the duties on raw material and the instruments of industry removed, no sound or necessary branch of manufactures would be crippled, while many would be benefitted, and a respectable export trade in manufactured goods might be expected.

It may be asserted that both of these large measures require a change of public opinion and a reversal of popular decisions which cannot be anticipated during this generation. It may be admitted that strong prejudices stand in the path of advancement. But the alternative policy of subsidies has the condemnation of the American people stamped upon its record. The grant of public money to promote speculation, and the payment of vast sums "ostensibly for carrying imaginary mails," have produced too many scandals and

developed too many public beggars and public plunderers. Until the criminal courts have completed the trials of the men who established the star-route system on land, that system will hardly be extended to the sea.

Legislative action is slow and uncertain upon such questions as we are now considering, and public opinion has not yet awakened to the unfortunate reality of the decadence of our maritime prosperity. In the meantime that industry which has done most to extend the reputation and influence of the United States among the nations of the earth is almost ready to perish. Its tonnage, its earnings, and its efficiency are all steadily declining. We do not replace our worn-out and rotten ships, we fail to compete with foreign vessels on the high seas, and our vessels have abandoned the international carrying trade to engage in a mere supplementary coasting trade. The magnificent growth of our foreign commerce has been accompanied by a steady decline in our shipping. The protected coasting trade is languishing, and the protected shipbuilding establishments demand subsidies to prevent their dissolution. The commercial interests, the defensive power, and the national honor of our country all suffer from these deplorable circumstances.

Our navy has gone down with our merchant marine, until a naval officer visiting a distant seaport in one of our men-of-war, often finds himself confronted with two hard questions. The first is: "Why do you come here, where no merchant vessel ever shows your flag?" And after the questioner has examined the ship he proceeds to ask: "How did you get here in such an antiquated and clumsy craft?" We may escape these questions when our legislators realize the present condition of our shipping. It may be decided that we have no further use for a navy when we cease to have a merchant marine. Let us hope, however, that the liberty and encouragement necessary to revive our merchant marine may soon be granted, and the dignity and usefulness of the navy thus established. In conclusion, I will say that, while this essay has insisted at some length upon the humiliating condition of our merchant marine, I have never asserted that its decay was inherent or without remedy. I can only repeat, with the cheerful pessimistic philosopher of France, the pregnant phrase, *Mais il faut cultiver notre jardin.*

NAVAL INSTITUTE, ANNAPOLIS, MD.

March 9th, 1882.

Commander H. B. Robeson in the Chair.

OUR MERCHANT MARINE: THE CAUSES OF ITS DECLINE, AND THE MEANS TO BE TAKEN FOR ITS REVIVAL.

By Lieut.-Commander F. E. Chadwick, U. S. N.

"*Spero meliora.*"

What is the measure of the desirability of the carrying trade? The total payments of freight money in 1879 were estimated by Dr. E. H. Walker, Statistician of the New York Produce Exchange, at 133,000,000 of dollars, of which 88,000,000 were paid for exports and 45,000,000 for imports.* As our exports by sea in 1880 exceeded those of 1879 by 16 per cent., and our imports for 1880 exceeded those of 1879 by 63 per cent.,† we may fairly estimate that there were paid to shipowners whose vessels were in the American trade, in the last fiscal year, not less than 177,000,000 of dollars for ocean-borne freights.‡ Not less than $11,000,000 were paid by cabin passengers coming to and going from the United States, and not less than $12,500,000 were paid by immigrants.

American vessels carried in 1880 22 per cent. of our imports and 13 per cent. of our exports, so that the owners of foreign bottoms received $146,000,000 of this freight money against $31,000,000 received by Americans. Add $10,000,000 of the passage money paid by cabin passengers to the foreign freight receipts, and all the

* American Shipping. Atlantic Monthly, Feb. 1881. By Henry Hall.

† Our total exports and imports in 1880 were $1,613,770,663, against $1,202,708,614 in 1879.

‡ The average of freights did not materially differ in the two years.

immigration money, and we have a total of 168,500,000 dollars as the amount paid to foreign bottoms in the American trade. This is much more than twice the excess of our imports of specie over our exports in 1880 ($75,891,391); is more than the excess of our exports of merchandise over the imports ($167,683,912); is 37 per cent. of the total value of our wheat crop in 1880 ($453,558,371); is more than 27 per cent. of the value of our corn crop ($617,485,125), and is about 60 per cent. of the value of our iron production in the same year ($296,557,685).

I give these statistics to show that from a money point of view this carrying trade is worth striving for, and that it represents a gigantic industry. Thirty years ago the relative positions of American and foreign tonnage were almost exactly reversed, and our merchants of that period could hardly have imagined that the time would so soon come when only 17 per cent. of our ocean commerce would be carried in our own ships.*

Given ships, the ocean whereon to sail them, with freedom to enter almost every port in the world, why should we find it more difficult to make money in such a calling than do the men of other nations? Even before the Revolution, American ships were feared by British commercial circles as rivals, and, by 1790, our flag had found its way to almost every sea. By 1800 our over-sea tonnage was almost double that which it was ten years before (667,107 against 346,254); and thenceforward there was a general advance, with occasional reverses, until, in 1850, we almost equalled Great Britain in the carrying capacity of our ships, and had far outstripped her in the quality of our vessels and of the officers and men who sailed them.

This was the golden age of sailing ships. The American clipper, with yacht-like hull, perfect equipment, and commanded by men who were as a body unequalled then and scarcely since, were the favorites the world round, obtaining the highest freights, the lowest insurance, and making the quickest passages. The Flying Cloud, the Challenge, the Great Republic, are names of a day when we bade fair to possess the commercial sovereignty of the sea; and it is hard to realize, looking at the port of New York to-day, that the time was so shortly since when we felt thus secure in our supremacy. Steam was then but just beginning to assert itself. We had (1850) 44,942 tons of

*In 1821 we carried 89 per cent.; 1850, 72; 1856, 75.2; 1860, 66.5; 1870, 35.6; 1875, 25.8; 1880, 17.4.

registered steam against the 187,631 of the United Kingdom. We were upon the eve of a change which our shipping-men failed to foresee, but which Englishmen did; and with this change disappeared our superiority. The decade between 1850 and 1860 saw scarcely any material advance in our registered steam tonnage; it touched its highest point in 1855, when there were 115,045 tons. The war came, and gave an increased momentum to the downward course of our sailing fleet; and in the sixteen years which have passed since our civil contest ended we have gone from bad to worse, and to-day have but half the registered tonnage of 1861 (1,352,810, against 2,642,628).

The history of the growth of our shipping interest is an interesting one; its beginnings were almost simultaneous with the establishment of our New England colonies, those of the southern portion of our coast showing no greater tendency to seafaring in the early days than they do now. This, however, was in the nature of things; the sterile and rocky coasts of New England enforced the seeking of a livelihood in some other way than by agriculture, and the men of the eastern colonies early became the carriers for those of the more fortunate lands of the south; the Newfoundland fisheries, too, famous for many years previous, were near at hand, and the people of Massachusetts Bay were not slow to use the immense advantage which proximity gave to them over the fishing fleets of England and France, which, years before any settlement in the present United States, had come yearly to the Banks. The first New England vessel entered the Thames in 1638, a remarkable fact, indicative of the energy of a colony of but eighteen years' growth, who so soon were able to practice one of the most difficult of arts, and to become in a few years largely their own carriers.

The trade between the mother country and the plantations quickly grew to great importance,* and the endeavor to secure this trade exclusively for her own shipping, combined with the desire of injuring the Dutch, who at that time had nearly half the tonnage of the world, led to the passage by England of the Navigation Acts of 1650 and 1660, whereby the Dutch, who had largely entered into the American trade, were excluded.

The growth of our carrying trade, the laws which now govern it, its prosperity and its decline, are so intimately connected with

*Sir Josiah Child estimated in 1670 that two-thirds of British shipping was employed in the American trade.

that of Great Britain, that a statement of the origin and changes of the British Navigation Laws must necessarily have a place in any philosophic discussion of this question. An able resumé is given in the evidence of Sir Stafford Northcote, at that time legal adviser to the Board of Trade, before the Parliamentary committee on the subject of the Navigation Laws in 1848. I shall take this evidence as a basis, as it was a clear and continuous statement by a high authority of the origin, growth and changes of the law which the free trade party of England was so desirous of abolishing, and which was abolished in the early part of the succeeding year (1849), against the strenuous and unremitting and well-intentioned efforts of the shipbuilding interest of the country. It is amusing to read now, in the light of after-events, the prophecies of the woe which was to follow the repeal of these famous acts.

The existence of these laws may be said to date from the time of the Commonwealth, but the earliest Navigation Laws of England date from the fifth year of Richard II. This was an enactment that no English subject should be allowed to export or import any merchandise except in British ships, on pain of forfeiture of ships and goods. It was modified in the next year, when it was found impossible to carry it into effect, by putting in a clause providing that if British ships could not be had, foreign ships might be used. Some years afterwards another act was passed, providing that British ships should carry goods at reasonable rates, and if they did not do so, foreign ships might be employed. This was followed by another act about the time of Henry VII, fixing the rates which were to be charged by British ships. There were two or three acts also passed between the reigns of Richard and Elizabeth which prohibited the importation of particular articles except in British ships, but the general rule was that goods were to be brought at certain rates of freight, and if British ships were not to be had at these rates, foreign ships might be used.

In the reign of Elizabeth this policy was reversed, the restrictions on importing in foreign ships were altogether abolished, and any goods could be imported or exported in any ship whatever, with a proviso that if in alien ships they should pay aliens' duties; it was a law, not of navigation, but of discrimination. There were two motives for the change given in the preamble to this act, viz. that the existing laws were injurious to commerce, and that it provoked the retaliation of foreign states.

The unimportant statutes between this and the time of Cromwell had relation to the colonial trade. The principal object of these acts was to cause the produce of the colonies to be sent to England, but they did not restrict their being sent in any particular ships. There was, however, an act in 1646 which removed the export duty on goods sent from England to the colonies in English ships, which amounted in fact to a discriminating duty in favor of these ships.

Foreign ships were first excluded from English colonies in 1650. Several of the colonies had remained on the side of the Stuarts and had given offence to the Commonwealth, and all trade with them was prohibited. The act of 1651 was the parent of the Navigation Act proper of 1660, and prohibited importation into England of the products of foreign countries, except in British ships, or in ships of the country of which they were the produce or from which they were generally exported. It appears this act originated from hostility to the Dutch, in order to destroy their very extensive carrying trade,* though this does not appear upon the face of the act in any way. The expression of Adam Smith is well known, that "national animosity aimed at the same object which the most deliberate wisdom would have recommended." "It had been observed with concern that for several years past the merchants of England had usually freighted Dutch shipping for fetching home their merchandise, because their freight was at a lower rate than that of English ships. The Dutch shipping was employed in the importation of our own American products, whilst our own shipping lay rotting in our harbors; our mariners, also, for want of employment at home, went into the service of the Dutch."†

In the reign of Charles II, one of the first enactments‡ was to re-enact the laws of the Commonwealth, combining the colonial system established by Cromwell, and the navigation, in one act, commonly known as the First Navigation Act. The preamble of this act puts it on the footing of the encouragement of British shipping. In Cromwell's law there was no distinction as to *build* of ships. In the

*A pamphlet, ascribed to Sir Walter Raleigh, laid before King James in 1603, entitled "Observations concerning the Trade and Commerce of England with the Dutch and other Foreign Nations," says: "The Dutch everywhere surpassed us, they had as many ships and vessels as eleven kingdoms of Christendom, let England be one"; and Sir Wm. Petty in 1670, estimating the total tonnage of the world at 2,000,000, places the share of the Dutch at 900,000.

† Macpherson, Vol. II, p. 442.

‡ 1660.

Navigation Act of Charles II, the trade of the plantations was confined to ships owned by the English, or built in the plantations, but it was not until 1662 that it was enacted "That no foreign-built ship shall enjoy the privileges of English or Irish built ships, even though the owners be Englishmen; prize ships only exempted."* "This statute," says Sir Stafford Northcote, "did not wholly prohibit the employment of foreign-built ships, but subjected them to aliens' duties on the same principle that aliens were always charged double duties." Sir Stafford continues, "In 1686 the British coasting trade was closed to foreign-built ships, the preamble of the act citing the decay of the shipbuilding trade as the cause, although ever since the time of Elizabeth it had been confined to ships owned by British subjects." Thus, notwithstanding the closure of the trade of the colonies to foreign shipping, it is clear that the home shipping trade was not in a happy condition. There can be no question, of course, that some benefits accrued from the exclusive use of British ships in the colonial traffic. A new world was opening up, and the rapidly increasing demand for tonnage would in any case have given some impetus to the shipping trade; but the Dutch, in spite of the repressive measures chiefly levelled at them (a fact which they so fully understood that we have the famous naval contests between themselves and the English as mementoes of the period), still prospered, and it is clear that in 1680, after thirty years' restriction, the Dutch occupied much the same status in relation to the English that the latter occupy towards ourselves to-day.†

There was much complaint of the action of the Navigation Laws in the colonies. Sir William Berkeley, Governor of Virginia, in 1671, says: "Mighty and destructive have been the obstructions to our trade and navigation by that severe act of Parliament which excludes us from having any commerce with any nation of Europe but in our own ships; we cannot add to our plantations any commodity that grows out of it, as olive trees or cotton or vines. Besides this, we cannot procure any skilful men for our own hopeful commodity of silk, and it is not lawful for us to carry pipe-stems or a bushel of corn to any place in Europe out of the king's dominions. If this were for his majesty's service, or the good of the subject, we should not repine whatever in our suffering, but on my soul it is contrary for both, and

* Ricardo's Anatomy of the Navigation Laws, p. 27.

† See Ricardo, pp. 28, 29.

this is the cause why no small or great vessels are built here. For all are most obedient to the laws, whilst the New England men break through them and trade to any place that their interest leads them to."* The words of the act of 1663 will fully explain the grounds of this complaint. It was then enacted "*That for the further improvement of former Navigation Acts, no merchandise of the growth, production or manufacture of Europe shall be imported into any of the English plantations or factories in Asia, Africa, or America, but what shall be laden in England in English-built shipping, and navigated by at least three-fourths English mariners, and shall be carried directly from England, and nowhere else, on forfeiture of ships and ladings; and none of the products of English plantations, viz. sugar, tobacco, ginger, fustic and other drugs, shall be carried anywhere (except to other plantations) till they be first landed in England, under the like forfeiture of ships and cargoes.*"† Scotland was not admitted to the trade of the plantations until the union in 1706, and Ireland not until 1780. The prohibition of trade between the colonies and foreign countries held until 1766, but there had been throughout these years a lucrative illicit traffic with the foreign West India colonies, which the British government was obliged to largely ignore.

It is clearly to be seen from all that is said on this subject, whether by Child, Macpherson, Chalmers, or by those who testified before the committees of 1844–1848, that the commerce with the American colonies had a paramount influence upon the direction of British laws regarding shipping up to the period of our Revolution. A field for the employment of shipping had been opened far surpassing in importance any ever before known. Sir Josiah Child, an enthusiastic supporter of the Navigation Act, estimated in 1670 that two-thirds of English shipping was employed in the American trade; the energetic Dutch had been forced elsewhere, and the whole of the great and growing traffic was in the hands of England, who, in the light of the times, was conscious of having right on her side; no one at that period expressing a thought that colonies were founded other than exclusively for the benefit of the mother country. But it was soon seen that their fellow-countrymen on this side of the Atlantic were also to claim a share in this trade, and American competition had so increased by 1725 that in that year "the shipwrights of the river

* Evidence of Sir Stafford Northcote, 1848.

† Ricardo, p. 33.

(Thames) came up to Whitehall with a complaint that their business declined and their workmen emigrated because the plantations furnished England with ships."* English trade in other ways was suffering; the manufactures established in the colonies were beginning to seriously interfere with the sales of the British merchant. A commission of the House of Commons at this time, in a report upon the subject, states "that it were wished that some expedient might be fallen upon to direct their thoughts from undertakings of this kind. So much the rather that those manufactures in process of time may be carried on in a greater degree, unless an early stop be put to their progress, by employing them in naval stores."† An attempt was even made to prohibit the exportation of the "great numbers of horses and great quantities of lumber" from the continental colonies to the foreign sugar colonies, on the ground that the latter were thus "enabled to more easily carry on their sugar plantations." A bill to this effect passed the Commons, but failed in the House of Peers.‡

In 1733, however, a tax of 6d. per gallon of molasses and 5s. per cwt. of sugar was laid on all such imported from any but the British West Indies (6 Geo. II. c. 13), naturally to the great grievance of the North American colonies, who were thus prevented bringing return freights from any islands than those subject to the British crown. In this same year too, "as the manufacture of hats had long since been brought to perfection in England, and great quantities thereof annually exported to foreign ports, and particularly to the British American plantations till of late years; and as great quantities are now made in the northern plantations, and from thence exported to foreign markets which were heretofore supplied therewith from Great Britain, for remedy thereof it was enacted that no hats or felt whatever should be exported from any of the plantations to foreign parts, nor be laden with that intent, under forfeiture thereof, and of £500 for every such offence." None were permitted to make hats in the colonies but those who had served an apprenticeship of seven years, and "no master is to have at any time above two apprentices, nor employ any negro in that manufacture" (5 Geo. II. c. 22). "The conveniences, in point of cheapness, which the Americans have beyond their mother country in the plenty of beaver, hair, coney-wool and many other furs gave them such advantages that, had they not been thus restrained, they would soon have supplied all the world with hats."§

* Chalmers, p. 122.

† Macpherson, Vol. III. p. 187.

‡ Macpherson, Vol. III, p. 172.

§ Macpherson, Vol. III. p. 178.

I give the above to show something of the restrictions of our early commerce; but lest this be thought exceptionally absurd, it is well to state that the regulation regarding the number of apprentices had held in England for many years previous, and it was not so dissonant with the public opinion of the time as one would think; only one hundred years before (in 1630), "the King issued another proclamation against erecting houses on new foundations in London, Westminster, or within three miles of any of the gates of London or of the palace of Westminster; also against entertaining inmates in houses, which would multiply the inhabitants to such an excessive number that they could neither be governed nor fed."* Such interference with affairs was frequent, and even extended to insistance upon the deprivation of the mass of the people from eating meat in Lent, "so that the fisheries of the kingdom might be encouraged, and the number of seamen employed therein increased." These are but examples of the interference with personal liberty of a comparatively unenlightened age. It took many generations to produce a mind in England wise enough to doubt that such laws as applied to foreign intercourse were otherwise than right and efficacious. In 1849 she shook herself free of the trammels which even then her shipbuilders and thousands of others, men generally wise in affairs, regarded as her safeguard. More than thirty years have passed since then, and we are still clinging to laws patterned after those which England has discarded. It would seem axiomatic that permanent prosperity cannot be secured by beggaring our neighbors, but it is precisely this principle which governed the legislation of Great Britain for two centuries, and which still has its weight in ours to-day.

From 1733 onwards the restrictions regarding our commerce increased, and at the time of the beginning of the War for Independence the American colonies could import or export nothing but in British vessels (colonial ships however being regarded as British).

They could not export the most important articles of their produce to any part of Europe other than Great Britain.

They could import no goods from any part of Europe other than Great Britain.†

Notwithstanding these and other laws of like tenor, our shipping had grown and prospered. On the register of the underwriters at Lloyd's for 1775, comprehending the shipping of the three preceding

* Macpherson, Vol. III, p. 178.

† Ricardo, p. 33.

years, there were 3908 British-built vessels of 605,545 tons, and 2311 of American build with a tonnage of 373,618.*

Macpherson gives the following returns of vessels built in three years before our commerce had become seriously affected by the preliminary difficulties of our struggle.

	1769.			1770.			1771.		
Colony.	Square rigged vessels.	Sloops and Schoon.	Tons.	Square rigged vessels.	Sloops and Schoon.	Tons.	Square rigged vessels.	Sloops and Schoon.	Tons.
N. Hampshire.	16	29	2425	27	20	3581	15	40	4991
Massachusetts.	40	97	8013	31	118	7274	42	83	7704
Rhode Island.	8	31	1428	16	49	2035	15	60	2148
Connecticut...	7	43	1542	5	41	1522	7	39	1483
New York....	5	14	955	8	10	960	9	28	1698
New Jersey...	1	8	83	..	..	....	..	2	70
Pennsylvania..	14	8	1469	8	8	2354	15	6	1307
Maryland.....	9	11	1344	7	10	1545	10	8	1645
Virginia......	6	21	1269	6	15	1105	10	9	1678
North Carolina	3	9	607	..	5	125	..	8	241
South Carolina,	4	8	789	..	3	52	3	4	560
Georgia.......	0	2	50	..	3	57	2	4	543
Totals......	113	276	20,001	118	282	20,610	128	291	24,065

Chalmers estimates the value of our imports from the West Indies immediately preceding the Revolution at £500,000 sterling yearly.

In 1772, 282 American vessels of 32,457 tons cleared from the British West Indies, against 397 English of 63,114 tons. Notwithstanding the effort of the Government in 1766 to rigidly enforce the laws of non-intercourse with the foreign West India colonies, the trade thither was too valuable and important to be given up. The Spanish islands afforded us our chief supply of silver, and this supply enabled us to pay for the large excess of our imports from, over our own exports to, Great Britain, the balance of trade between ourselves and the mother country being previous to 1764 largely against us. The following tables show the state of our trade in 1769, though at this time it was somewhat injuriously affected by the parliamentary enactments of the preceding five years.

* These statements give an idea of the size of the ship of the day, none but the larger being so registered. The average ship was of about 200 tons.

IMPORTS IN £ STERLING.

	From Great Britain.	From South of Europe	From West Indies.	From Africa.	Totals.
New Hampshire..	223,696	652	48,529	......	564,034
Massachusetts....		21,908	155,387	......	
Rhode Island....		2,581	56,840	180	
Connecticut......		267	53,944	......	
New York.......	75,831	14,927	97,420	698	188,976
New Jersey......	....	327	1,644	......	1,990
Pennsylvania.....	204,980	14,249	180,592	......	399,820
Maryland........	714,944	4,683	32,198	5,400	851,140
Virginia.........		9,442	77,454	7,020	
North Carolina...	327,083	933	10,604	1,080	535,714
South Carolina...		6,166	65,666	124,181	
Georgia..........	58,341	547	9,407	13,440	81,735
Totals........	1,604,975	76,684	789,754	151,998	2,623,412

EXPORTS IN £ STERLING.

	To Great Britain.	To South of Europe.	To West Indies.	To Africa.	Totals.
New Hampshire..	142,775	464	40,431	97	550,089
Massachusetts.. ..		16,702	123,394	9,801	
Rhode Island....		1,440	65,226	7,815	
Connecticut.. ...		2,567	79,395	......	
New York.......	113,882	50,885	66,324	1,313	231,906
New Jersey......	......	......	2,531	560	22,531
Pennsylvania.....	28,112	203,752	178,331	......	410,757
Maryland	759,961	66,555	22,305	......	991,401
Virginia.........		73,635	68,946	......	
North Carolina...	405,014	3,238	27,944	72	569,584
South Carolina...		72,881	59,814	619	
Georgia..........	82,270	614	13,285	......	96,179
Totals........	1,531,516	552,736	747,910	20,278	2,852,447

An annual average of 2,953,042 gallons of rum were imported from 1770–1773 from the West Indies to the present United States, besides molasses, nearly the whole export of which came to New England for the manufacture of rum.* Not all of this rum was used in the United States however; in 1773, 608,025 gallons went to Nova Scotia, Quebec and Newfoundland, and 416,366 gallons to Africa, for purposes which can be easily understood. New England was not at that time careless of the profits to be derived from the slave trade (in this however being not below the level of the opinion of the time),

* Chalmers.

and held to them with a tenacity which made itself felt in nationa legislation on the subject many years later.

The close of the Revolution found us with but little shipping on our hands, excepting the privateers which had been successful, the vessels which had been captured, and the regular ships of war which we built or purchased. But that the first served as a good school for seamen is shown by the statement made in the House of Peers in 1778,* "that 733 vessels had been taken by the Americans, of which forty-seven had been returned and 127 retaken. The value of the remainder appeared from the statements of merchants to be at least £2,600,000. . . . Insurance to the West Indies was raised from two and a-half per cent. with convoy, and to fifteen without, though in general no insurance at all could be made on ships in such circumstances." Coxe's "View of the United States of America"† says, "The most important consequence of the expulsion of American fishermen from their legitimate employment was that almost all the men and fast sailing vessels were immediately employed in privateering, and that 1095 British vessels were carried, in the course of the war, into the ports of Boston, Salem, Beverly, Newburyport, Marblehead, Gloucester, Haverhill and Ipswich, in the middle district of Massachusetts Bay, as appears by the record of the maritime court, besides what were carried into other ports, and those that were retaken, which were estimated to have been about half as many as were carried into port by the captors. At least 550 sail were computed to have been taken by the privateers belonging to the other two districts of Massachusetts Bay; and those belonging to the fishing ports of the other New England governments were equally successful in destroying British commerce. Infinitely better," continues the author, "had it been for British merchants if the hostilities of these men and vessels had still been directed against whales and cods." These captures show in themselves the extent to which our shipping interest had already grown. With peace came the question of the status of American ships in trade with British dominions. Mr. Adams represented our willingness to enter into a commercial treaty, and he proposed that the United States and the United Kingdom and its colonies should be placed somewhat on the same footing as to commercial and maritime affairs as before the war; the principal

* Macpherson, Vol. III, p. 611.

† Mr. Coxe, of Philadelphia, was an officer of customs for many years and had exceptional facilities for obtaining accurate statistics.

demand being that the ports of the United States and those of the West Indies, as also those of British North America, should be on a reciprocal footing of navigation and trade. The West India colonies urgently upheld this demand; opinion in England was much divided, and there was a war of pamphlets, relics of which we have in the volumes of Mr. Chalmers and of Lord Sheffield, both of whom were vehemently opposed to this view; the latter going so far as to advise that the Barbary corsairs should be treated as leniently as possible, as, the United States having no navy, our commerce with southern Europe would fall an easy prey, and England would thus be rid of a rival in this trade without trouble or expense to herself.

Mr. Pitt, then prime minister, leaned to the broader and wiser view, and brought forward a bill, March 5, 1783, authorizing a free and entire intercourse between the United States and the British dominions, but his ministry going out on the 2d of April on another question, it was defeated under the succeeding ministry, and an act was passed enabling the king to regulate the trade between the two countries by orders in council. The new government held to a rigid interpretation of the Navigation Acts, and the orders in council issued allowed only certain enumerated articles to be imported from the United States to the West Indies, and these only in British vessels.

The extreme rigidity of the orders issued in this and succeeding years occasioned very great dissatisfaction and resentment in America. The General Court of Massachusetts passed at act prohibiting the export of any American products or manufactures from their ports in vessels owned by British subjects after August 1, 1785; the temper of other colonies was shown in similar resolutions, and on the meeting of the first Congress in 1789 one of the most important questions before it was that of the regulation of our foreign commercial intercourse.

This question of the regulation of commerce had been intimately associated, in the convention which framed the Constitution, with that of the slave trade. An able resumé of the proceedings on this subject is given by Mr. David A. Wells in the New York *World* of February 21, 1881. "The fourth section of the seventh article of the Constitution of the United States as originally reported by the Committee of Detail, provided that 'no tax or duty shall be laid by the legislature on articles exported from any State, nor on the migration or importation of such persons as the several States shall think proper to admit; nor shall such migration or importation be prohibited.'"

Mr. Luther Martin, of Maryland, held this latter clause as "inconsistent with the principles of the Revolution, and dishonorable to the American character to have such a feature in the Constitution." Messrs. Rutledge and Pinckney, of South Carolina, and Mr. Baldwin, of Georgia, warmly protested against Mr. Martin's proposition to amend this section by authorizing Congress to lay a tax or prohibition at discretion upon the importation of slaves, as uncalled-for interference with the slave trade. Mr. Ellsworth and Mr. Sherman, of Connecticut, were both for leaving the clause as reported. "Let every State," they said, "import what they please." George Mason, of Virginia, expressed himself with great energy in opposition to the views of the delegates from Connecticut. "This infernal traffic," he said, "originated in the avarice of British merchants," and "he lamented that some of our eastern brethren had, from lust of gain, embarked in this nefarious traffic." The whole question was finally referred to a committee; and what this committee did is told by Luther Martin, one of its members, in a letter to the Speaker of the Maryland House of Delegates. "I found the Eastern States, notwithstanding their aversion to slavery, very willing to indulge the Southern States, at least with a temporary liberty to prosecute the slave trade, provided the Southern States would gratify them by laying no restriction on the enactment of Navigation Acts; and after a little time the committee agreed on a report by which the general government was to be prohibited from preventing the importation of slaves for a limited time, and the restrictive clause relative to Navigation Acts was to be omitted." (Elliott's Debates, second edition, Vol. 1, p. 373.)

"The limit set by this committee was 1800; but when the report came before the convention, Mr. Pinckney, of South Carolina, moved to amend by substituting 1808 in lieu of 1800, as the term of the permitted traffic, and this motion was seconded by Mr. Gorham, of Massachusetts." In the vote carrying this amendment, "all of the three New England States, with South Carolina, Georgia, Maryland, and North Carolina, voted for it, and Virginia, Pennsylvania, New Jersey, and Delaware, voted against it."

"Thus by an understanding, or as Gouverneur Morris called it, 'a bargain,' between the commercial representatives of the Northern States and the delegates of South Carolina, and in spite of the opposition of Maryland and Virginia, the unrestricted power of Congress to enact Navigation Laws was conceded to the Northern merchants;

and to the South Carolina rice-planters as an equivalent, twenty years' continuance of the African slave trade." (Hildreth's United States, Vol. III, p. 520.)

The first Congress thus imposed discriminating duties on articles imported from India or China in foreign vessels, by act approved July 4, 1789.

July 20, 1789, a tax of six cents a ton was laid on vessels belonging to citizens of the United States; thirty cents a ton on vessels built in the United States belonging wholly or in part to subjects of foreign powers; and fifty cents a ton on all built and owned abroad. This tax, in the case of vessels built and owned in the United States, and employed in the coasting trade or fisheries, was payable yearly; in all other cases at every entry.

Efforts were made later to increase this tax, but to this the Southern States as a rule were opposed, claiming that these restrictions were in general detrimental to their commerce, as they were obliged chiefly to depend upon foreign tonnage for the export of their products.

Dec. 31, 1792, the Registration Act, in substance as it is to-day, was passed.

Feb. 18, 1793, the coasting trade was wholly closed to foreign vessels. Our own sea traffic had rapidly increased; our ships had found their way to China by 1785, and were pushing themselves everywhere where trade was possible. The political complications of Europe were at this time a great aid, as we were about the only neutral bottoms, but later it would seem to us of to-day that the risks of such trade much more than outweighed the benefits.

Judging from the general tenor of the expression of opinion on the part of the best known men of this period, one cannot but think that our laws at this time were retaliatory in character rather than being the expression of a settled policy. The conduct of Great Britain made such laws a necessity. The country at large would have been much better satisfied with a free and unrestricted trade in shipping. Our present laws are the legacy of a procedure forced upon us; though a fitting of ourselves to actual circumstances has brought us to believe, as the English believed of theirs, that success can only lie in their retention.

The excessively unsatisfactory state of our commercial relations with Great Britain led to the special mission of Mr. Jay and to the formation of the treaty of 1794. By this treaty the citizens of the United States were permitted to carry, in vessels not exceeding

seventy tons, to the British West Indies, all such products and manufactures of the United States as could be lawfully carried from the United States to the Islands in British vessels, and also carry back all West Indian produce that might be lawfully carried in British vessels. No discriminating duties were to be levied by either country. The United States, however, were expressly debarred from carrying molasses, sugar, coffee, cotton, &c., the produce of the West Indies, to any other part of the world. The liberty of continuing to trade to the territories of the British in the East Indies was confirmed ; the government of the United States engaging that such vessels as traded thither should carry goods from India only to America. This treaty was sanctioned by the United States, April 20, 1796, though the British Parliament did not pass the act for carrying it into effect until July 4, 1797.

We had now entered upon the stormy era in which our shipping interests were ground between the upper and nether millstones of British and French aggression and spoliation. The American state papers of the period afford most curious reading. Our ships were seized in all waters under any or no pretext. "According to a document sent to Congress in 1812, the number of the British captures and seizures of vessels since the commencement of the continental war was 917, of which 528 had occurred previous to, and 389 since, the orders in council of Nov. 1807. The French seizures and captures were 558, of which 206 were before, 317 under, the Berlin and Milan decrees, and 45 after the alleged repeal. The Danish captures amounted to 70 and the Neapolitan to 47 (properly French). The actual losses, however, by France exceeded those suffered from England"* (on account of the much greater number condemned and destroyed). Our claims against France on account of these spoliations amounted to 80,000,000 francs.

The trade carried on in the face of the outrageously sweeping and rigorous decrees of Napoleon and the British Government must have been enormously remunerative, else there had been a general outcry for war. As it was we had a short-lived maritime contest with France, but in the succeeding years we underwent tremendous humiliation and losses. In spite of these our tonnage gradually crept up. 346,254 in 1790, it was 529,471 in 1795, 667,107 in 1800, 744,224 in 1805, 981,019 in 1810.†

* Hildreth's History of the U. S., Vol. VI, p. 12.

† Our total tonnage in the years was, 1790, 478,377; 1795, 747,965 ; 1800, 972,492 ; 1805, 1,140,367 ; 1810, 1,424,783. In 1793 our exports were $25,517,345, of which

These figures show a wondrous energy and enterprise on the part of our merchants and shipowners in the face of the difficulties which beset them.

In 1811 our registered tonnage suddenly fell to 763,607, and in 1814 had decreased to 574,633, reductions due to the war of 1812 and the troubles preceding it. By the treaty of 1815 the equalization of the duties on tonnage and imports was extended to the vessels of both nations as far as related to the British dominions in the East and the United States. By that treaty the English confirmed to the United States free direct communication with their East Indian possessions, and British merchandise and vessels were exempted from payment of extra duties, provided the vessels arrived from the East Indies and the merchandise consisted of their growth, produce or manufactures. There was, however, a special provision that the intercourse between the British West Indies and the United States should remain as before. Retaliatory enactments on our part had their effect. Our ports were virtually closed by laws of 1817 and 1818 to British vessels coming from British North America and West Indian colonies. The President was empowered to open our ports by proclamation on the same terms as those granted our shipping in foreign ports, and in 1822 there was a considerable relaxation in British colonial trade. In 1823 arose another war of restrictions, which did not cease until perfect reciprocity was established in 1830; and in November of this year a British Order in Council was issued, "authorizing vessels of the United States to import into British possessions abroad any produce of the United States from those States, and to export goods from the British possessions abroad to any foreign countries whatever." Previous to this we had entered into relations of reciprocity with nearly all the Northern European States, much to the benefit of our trade, especially with North Germany.

The whole history of our legislative enactments during this time in relation to shipping clearly shows a willingness to place foreign

27 per cent. were from Pennsylvania. This was about equal to $6 per head of our population, the estimate in 1790 putting this at 3,928,626; in 1880 our exports were $16.45 per head. In 1796 the State of Massachusetts exported produce, etc., to the value of $9,949,325; New York, $12,288,027; Pennsylvania, $17,549,141; a great part of this increase must be ascribed to the increased importation of West Indian produce, which was carried to America to be reshipped to Europe in neutral bottoms. Our total exports in this year were about $45,000,000.

shipping upon an equal footing in our own ports with that granted our own abroad; and every act which loosened the trammels of commerce has but proved the wisdom of non-restriction. In 1830 we fully entered upon the era of reciprocity. Our registered tonnage had increased from 674,633 in 1814 to 854,295 in 1816, from which it almost as quickly decreased to 589,954 in 1818. Our shipbuilders had not taken into account the immense British tonnage set free by the general peace,* and had overbuilt. It was not until 1838 that our steady upward rise began, and we entered upon a career that was as successful in its day as that of the English is to-day. There is a wide difference, however, in the circumstances; the instrument of our success was sails, that of the English steam.

The repeal of the British Navigation Acts in the year 1849 marks an era in the history of shipping. Loss of trade, decrease in the value of shipping property, failures among shipbuilders, brought about an agitation which resulted in this vital change, which fitly crowned the work of the men who brought about the repeal of the corn laws and had changed the character of Parliamentary representation.

These laws, as they stood immediately preceding the repeal, were as follows:

"1st. Certain enumerated articles of European produce could only be imported into the United Kingdom, for consumption, in British ships, or in ships of the country of which they were the produce, or in ships of the country from which they were usually imported.

"2d. No produce of Asia, Africa, or America could be imported for consumption into the United Kingdom from *Europe* in any ships; and such produce could only be imported from any other place in British ships, or in ships of the country of which the goods were the produce and from which they were usually imported.

"3d. No goods could be carried coastwise from one part of the United Kingdom to another in any but British ships.

"4th. No goods could be imported from the United Kingdom to any of the British possessions in Asia, Africa, or America (with some exceptions in regard to India), except in British ships.

"5th. No goods could be carried from any one British possession in Asia, Africa, or America to another, nor from one part of such possession to another part of the same but in British ships.

* The tonnage of Great Britain in 1815 was somewhat over 2,000,000.

"6th. No goods could be imported into any British possession in Asia, Africa, or America in any but British ships, or in ships of the country of which the goods were the produce; provided, also, in such case, that such ships brought the goods from that country.

"7th. No foreign ships were allowed to trade with any of the British possessions unless they had been specially authorized to do so by order in council; and

"8th. Powers were given to the Queen in Council which enabled her to impose differential duties on the ships of any foreign country which did the same with reference to British ships; and also to place restrictions on importations from any foreign country which placed restrictions on British importations into such country." *

This extraordinary series of laws, the product of two hundred years' legislation on the subject, repealed, added to, amended until it became in substance what has just been given, is a stupendous monument of unwisdom; the best example in the history of legislative enactment of blindly doing that least calculated to attain the desired end. I know no more valuable or interesting reading for the student of this subject than the testimony taken before the Parliamentary Committees of 1844 and 1847, whose reports formed the basis of the repeal. The bill passed the Commons in April, the Lords in May, and, June 26, 1849, received the Royal assent and became law; it having been opposed throughout in the most vehement manner by the entire shipbuilding interest of the country.

Our shipping at this time had come into most marked competition with that of Great Britain. Our registered tonnage had gone from 762,838 in 1840 to 1,047,454 in 1847. British tonnage in the same time had risen from 3,311,538 to 3,952,524, about one-fifth of which was colonial, but our ships were making money while theirs were not. As the period between 1840 and 1855 marks our era of greatest success in the carrying trade, the reasons for this success form a most important point in this discussion.

At this period the average of the percentage of American shipping in the total which entered our ports was about seventy per cent. In 1820 it was as high as ninety, and had remained about 88 per cent. until 1831, when it fell to 76.6; it gradually fell to 63 per cent. in 1837, but rose to 69 in 1838, and from thence on to 1847 was as stated. British tonnage at the same time was an average of 83 per

* Lindsay's History of Merchant Shipping, Vol. III, p. 107.

cent. of the total foreign tonnage which came to America. The annexed tables furnished the Parliamentary Committee of 1847 by Mr. Robert B. Minturn, of New York, are interesting as a statement of the state of our carrying trade.

TONNAGE OF UNITED STATES.

	Registered.	Coasting.	Total.
1816 } 16 years,	800,760	522,165	1,372,219
1832 }	686,990	649,627	1,439,650
	113,770	127,462	67,231
Decrease per cent.	14.20	Increase 24.4	4.87
1832 } 10 years,	686,990	649,627	1,439,550
1842 }	975,350	1,045,753	2,092,391
	288,369	396,126	652,941
Increase per cent.	41.97	60.97	45.36
Per annum	4.19	6.09	4.53
1842 } 4 years,	975,359	1,045,753	2,092,391
1846 }	1,130,286	1,315,577	2,562,084
	154,927	269,824	469,693
Increase per cent.	15.88	25.8	22.44
Per annum	3.97	6.45	5.60
1846 } 1 year,	1,130,286	1,315,577	2,562,084
1847 }	1,241,313	1,488,604	2,839,146
	111,027	173,025	276,962
Increase per cent.	9.82	13.15	10.81

Mr. Minturn's testimony was amongst the most valuable, as being that of one who knew intimately the state of our own shipping trade and was well acquainted with that of England.

It was clearly shown by repeated testimony that there was an undoubted preference given to American ships in the trade between England and the United States, and that in this trade Americans received higher freights. Captain Briggs, an American shipmaster, states that an American ship would receive one-sixteenth of a penny per pound more for freight on cotton than an English one, and he also estimates that we had two-thirds of the trade between Great Britain and ourselves. He thinks (Ques. 4846) that Americans carried more goods, making more trips in the course of the year, than the English; he attributed this largely to the fact that English masters were as a rule paid by the month, and Americans received a percentage on the cargo besides a fixed pay. American captains too were often

also part owners in the ship. The abolition of spirits on board ship he thinks had a most marked effect; insurance companies insured at lower rates, or (as testified Mr. Minturn) in the earlier days of the temperance movement the underwriters returned ten per cent. of the insurance on those vessels which made their voyages without spirits. The abolition of spirits also tended to decrease the number of men carried.

Our ships (Mr. Minturn) carried fewer men, but two and a half as a rule to the hundred tons against three and a half or four in the British service. The pay as a rule was much higher, $18 a month being paid in the Transatlantic trade* at New York against £2 10s. in Liverpool. The proportion of men to the tonnage given by Mr. Minturn referred "to ships of from 900 to 1200 tons, and which were manned with a view to making as short passages as possible." "In our common freighting ships we have a smaller number, say 2¼ to the 100 tons. The Henry Clay, 1207 tons American measurement, has 30 sailors, 2 boys and a carpenter. There is another ship of 1400, a three-deck ship, which measures about the same in American as English tonnage, and she had about the same number of men as the Henry Clay. The number carried has much diminished of late years. No ships of any nation carry heavier cargoes than ours, and as evidence that they did not suffer more than others it may be stated that they commanded through this year quite as high freights as any others, and were insured at lower rates."

A comparison was given by Mr. W. Phillips (Ques. 6606) of the crews carried in Hamburg and British ships and the wages paid per month, by which it appears that in these two of the same size the wages in the British vessel exceeded that of the other by more than £15 per month (£40 10s. against £25 2s. 8d.) In a British vessel of 448 tons, given as an example, the master received £10 per month, £5 table money, one-half of the freight carried in the cabin and two-thirds the cabin passage money; the ship provided each passenger with a foremast hand's rations, the master supplying what were regarded as luxuries. The mate received £5 5s., second mate received £3 10s., carpenter received £5, steward received £3, cook received £2 15s., sixteen seamen received £2 5s. each. The total monthly wages were thus £53 10s., exclusive of the captain's.

The cost of provisioning the men was in all the trades from 1s. 3d. to 1s. 5d. per day, being in this regard slightly in excess of the cost

* But $12 a month was paid in the China trade in American ships.—*Idem.*

in American ships, which Captain Briggs estimated at 30 cents a day.

The wages at this period in Prussian ships were: Master, £4 10s. per month; mate, £2 14s. per month; carpenter, £2 0s. 6d. per month; boatswain, £1 13s. per month; seamen, £1 7s. and £1 0s. 3d. per month; boys 13s. 6d. per month.

The number of men employed in Mr. Minturn's ships hardly give a fair idea of the number of men we employed at that time per hundred tons, as the vessels he owned were much larger than the average ship. In 1844, in an average of 575 American ships, 3.29 men were carried per 100 tons; in 1845, in an average of 741 ships, 3.22; in 1846, in an average of 744 ships, 3.19. In the same years the average numbers employed in British ships in trade with the United States were 3.96, 4.21, 3.72, respectively. These numbers include all except officers.

The cost of British ships was undoubtedly somewhat greater than those of most other nations; it being stated in the evidence as from £17 to £20 per ton ready for sea. This price was for vessels rating at the Lloyds A1 for twelve years. Mr. Minturn gave the price of the New York packets, "universally acknowledged to be the best ships built in America, all of which had in them a portion of live oak, as about seventy dollars per ton, exclusive of the cabins" (the cost of the cabins would in a 1200 ton ship add about five dollars a ton to the cost). English measurement differed however from American measurement, in that in England poop cabins were estimated, so that the Henry Clay of 1207 tons American measured 1467 tons English when she came to be measured for light dues in Liverpool. In flush-deck ships, however, the measurements were about the same.

It seems that the British ships employed in the general trade were much inferior to those in special trades, and from analysis of the evidence it seems quite clear that the cost of a ship in England was not greater than the cost of one of an equal class in America. Captain Briggs testifies that the first cost is equal, and that repairs are more cheaply done in England than here (in this differing with Mr. Minturn). As we imported all our iron, our chain cables, much of our canvas, all our sheet copper, and as much of our timber was brought from the Southern States (the Carolinas, Georgia, and Florida), and as our wages were much higher, one can hardly resist the conclusion that it must have been quite as expensive to put afloat a first-class ship here as in England. Mr. Young, a veteran English ship-

builder, and a vehement opposer of any change in the Navigation Laws, testified that "a ship built to stand for twelve years on the first letter would cost £18 per ton; it is my opinion that a ship so built as to stand for eleven years on the first letter would cost £1 less, or £17 a ton, and so downwards"—the ship costing one pound per ton less for each year taken from her standing. A ten-year ship would thus cost £16 per ton. Captain Briggs (American) testified that our ships which had cost £16 a ton to build in 1844, were costing £20 a ton in 1847 (in this differing very materially with Mr. Minturn), and "that the Americans have no ship that would stand for twelve years in this country" (England).*

It seems clear from an analysis of the evidence that our ships cost nearly as much as English ships of the same class.

That our wages for seamen were much higher, from sixteen to eighteen dollars against £2 5s. or £2 10s. That the cost of victualling was about equal.

That though we carried fewer men by 18 per cent., this difference was largely offset by the fact that a large part of the greater number in British ships were boys, which British law required to be carried as apprentices.

Wherein, therefore, was our superiority?

Our models were finer, which aided our ships in making more frequent passages.

Our captains had a greater interest in making quick and frequent passages, and in carrying the cargo in good condition; greater attention was paid to stowage, the master himself generally attending to this, instead of its being, as in British ships, looked after by a mate.

Our captains were men of far higher intelligence than most of those in other employ; many of the best and most substantial families of the country having representatives afloat as masters or mates of ships. Many of these officers had entered before the mast to learn their profession, or indeed this may be said of most of them.

* Ships were at this time building in Maine at from $57 to $58 a ton. Mr. Minturn states that they never rated above A2. Captain Snow, of N. Y., an experienced shipmaster, shipbuilder and owner, has, however, personally stated to me that they, in some cases, had the preference over British ships in this trade. Our cheaper class ships were, however, fully offset by the cheap ships of the Provinces, which the English could buy at much lower rates than we could build at any time and anywhere.

Finally, as the last of our own qualifications, our ships were temperance ships, "not one in a hundred," as was testified by Captain Briggs, "carrying spirits."

These good qualities would have availed us little had not England brought them so in relief by the character of her merchant officers. A circular was issued July 1, 1843, requesting information on this head from British consular officers, and the answers sent in clearly show one great reason for the greater trust in American ships and American masters. Consul Baker, of Riga,* says: "I am sorry to state that in my opinion the British commercial marine is at present in a worse condition than that of any other nation. . . . . . I have always been convinced that while British shipowners gain more by the more economical manner in which their vessels are navigated, they are great losers from the serious delays occasioned, while on the voyage and discharging and taking in cargoes, growing out of the incapacity of their shipmasters and their intemperate habits. I have had occasion to remark while Consul in the United States that American vessels, in particular, will make three voyages to two of a British vessel, ... and also from their superior education and consequent business habits, obtaining better freights and employment for their vessels on foreign exchanges." He also remarks further, "that he had been compelled on representations of the consignees, in several instances, to take from shipmasters the command of their vessels in a foreign port, and to appoint others for their return voyage," on account of their constant intoxication.

Consul General Yeames, at Odessa, says: "Some of the shipmasters are shamefully illiterate, and are not qualified to do justice to the owners in common transactions that occur in this port. They are indifferent to their cargoes and careless of their preservation." The Consul at Dantzig said, "Only lately a master left his vessel which was loaded with a valuable cargo and ready for sea, and was after several days' search found in a house of ill-fame; his mate very little better than himself, and his people, following his example, a set of drunkards." He said occurrences nearly as bad are by no means rare, and that a Prussian ship was sure to obtain a preference when freights were remunerative.

The reports from the Mediterranean, Brazil, and the United States, were quite as bad; the general accounts of the British shipmaster

* Lindsay, Vol. III, p. 43.

showing him as frequently incompetent, generally inebriate, careless of his cargo, and the conduct of his crew as being excessively bad.

In reading this testimony there can be no doubt as to whence a large part of the commercial favor granted our marine came. It was not our better models, though this was an element; it was not so much that we built or sailed our ships more cheaply; it was the character and intelligence of our masters which had weight here as in every other walk of life.

Mr. Minturn testified his conviction that none of this favor arose from national feeling, and was very emphatic in so stating; it was simply a question of safety, economy and despatch. He attributed the general increase of our tonnage to the opening of our internal communications and an augmentation of products to be exported; to the opening of mines, to the increase of manufactures. He thought that reciprocity had worked neither special good nor harm, and "that though some of our merchants had shortly after 1830 advocated another cause, opposition had now ceased."

We were now in the full tide of prosperity; the annexation of California came to add to our carrying trade; no others could clear from Atlantic ports for those on our Pacific coast than ourselves; the voyage from New York to San Francisco was ruled as a coasting voyage, and our clippers were thus enabled to proceed thence to China or the East Indies and freight from there for America (or England after the repeal of her Navigation Acts) at a great advantage over foreign competitors.

The English Navigation Acts were repealed in the face of a tremendous opposition from the shipbuilding interest of the country; property in ships depreciated, while the change was in question, to one-half or one-third its value, and it is almost amusing, as an example of shortsightedness, to read the words in which some of the earnest and able opponents of the repeal foretold the decadence of England's power and commercial influence; her ships were no longer to have employment, the carrying trade of the world was to go to America, and, worst of all, the Navy would no longer have a source from which to recruit its men, and England's safeguard would be impotent. They little saw that not many years after they would practically become the monopolists of the carrying trade, and that the Navy, instead of depending upon the merchant marine, would train its whole force from boyhood, and furnish the merchant service its most efficient and trustworthy men.

Why did we lose this superiority which statistics and all evidence show us to have possessed? Why were we within thirty years to carry only 17 per cent. of our freights instead of the 78 per cent. of 1850, though our foreign trade of last year was $1,613,770,633 against the $317,885,252 of the other date?

The first element of the change is found in the fact that the British employed better men to command their ships than they had done before; many American captains were induced into their service, and the rigid examination under the auspices of the Board of Trade was soon made a necessary step for the holding of a certificate; they changed their models, so that by 1856 they fairly held their own in speed, and American and British clippers leaving port on the same day in China, a few years later, took pilots in British waters at the same time. The English were wise enough to learn from the enemy and turned their knowledge to good account. We no longer had a monopoly of labor-saving methods; our double topsail yards, winches and blocks were soon adopted, so that in all these matters, captains, models, labor-saving appliances, &c., the British in a few years stood upon an equality with ourselves; the Merchant Shipping Act of 1854 (amended and added to in 1855, 1862 and 1867) was passed, furnishing an example of excellent legislation on the subject which it would be well for us to copy.

But the great and final cause of our discomfiture was the change from sail to steam and from wood to iron.

In 1847, 24,496 tons of foreign steam shipping had entered our ports against none of our own. Although we had been the first to successfully use the steam engine afloat, and had sent the first steamer across the Atlantic,* we were slow to learn that we were dealing with a great force which was to revolutionize our shipping methods, and indeed, judging by the persistency with which we cling to sails, have scarcely learned it yet. It is not until 1848 that we find an entry, 12,614 tons of American steam tonnage, and the race between the English and ourselves then began in which we came out decidedly the worse. The Pacific Mail Steamship Company was established in 1847; in 1838 the first British steamers had arrived in the United States, the Sirius and Great Western, of 700 and 1340 tons, both arriving on the 23d of April of that year. The practicability having been demonstrated, the Admiralty issued advertisements for

* The "Savannah," from Savannah to Liverpool, in 1819.

tenders for the conveyance of the North American mails by steam, and the contract was awarded to Samuel Cunard, who with George Burns and David MacIver formed the company to become afterwards so famous. The original contract was for £55,000 per annum, for which three ships were to be furnished and two voyages a month performed between Liverpool, Halifax, and the United States; another ship was afterwards added, and the price advanced to £81,000 per annum. The largest of these ships, which were all of wood, was 1156 tons gross (615 register); was but 207 feet between perpendiculars, and had 740 indicated horse-power. These ships began their service in 1840 between Liverpool, Halifax, and Boston. This was the beginning of what is generally called the subsidizing system, but it was really nothing more than a fair payment for mail service performed. We must remember that the British North American provinces, parts of the West Indies, the Cape of Good Hope, &c., are as much integral parts of the British Empire as our outlying Western Territories are parts of our own possessions, and I think we should find on careful inspection that no more has been paid by Great Britain to keep up mail communication with the distant portions of her dominions than has been paid by ourselves to give similar advantages under somewhat similar circumstances; the difference has been that her distant routes led across the sea, ours (with the exception of that to our Pacific coast for many years) are all by land.

In 1843 the Great Western Company, which had been much chagrined by the success of Cunard in obtaining the contract, built the Great Britain of iron, with a length of 296 feet between perpendiculars, and 322 over all; beam 51 feet; 2984 tons, and 1000 horse power, by far the largest ship then afloat. She was the first screw ship built for Transatlantic traffic, though from her stranding on the coast of Ireland she never performed the service contemplated. In 1845 Mr. R. B. Forbes put afloat the Massachusetts, an auxiliary screw-ship, which sailed for Liverpool in September of that year as a general carrier. She was chartered by our government in 1846 to carry troops to Mexico, and was afterward bought and known in the navy as the Farallones; she was sold again by the Government, and was again in the merchant service a few years since, with her machinery removed, as the Alaska.*

* Letter of Mr. R. B. Forbes, November, 1874. Lindsay, Vol. III, p. 191.

Our first attempt at competition with the Cunard Company was in the building of the Washington of 1750 tons, which started as the pioneer ship of a line between New York and Bremen (calling at Southampton) on her first trip in June 1847. In 1850 the Collins line was established, with a subsidy of $19,500 per voyage, twenty voyages being required yearly between New York and Liverpool; this subsidy was soon increased to $33,000 per voyage in return for an increased speed. The company began their service with the Arctic, Baltic, Atlantic, and Pacific, each of about 2900 tons register, with a length of 282 feet and a beam of 45. These steamers were all of wood and all straight-bowed, the latter a marked advance on the general idea of the day in steamship construction. The Cunard Company were then receiving £7 10s. sterling a ton freight, but in two years after, the rate from competition had fallen to £4. The British mail subsidy had also been advanced to £145,000, weekly trips being made by the Cunard Company's ships to Halifax, and thence alternately to New York and Boston.

In 1854 the Arctic foundered; the Pacific left Liverpool January 23, 1856, and was never afterwards heard of. The Adriatic, the most splendid steamer of her time, took their place in the Collins fleet, but in 1858 the company, after enormous losses, gave up the contest, and the knell of our Transatlantic steam traffic had been sounded. The attempt had been wretchedly managed; it was not a business-like effort, but rather one of national vainglory to beat the English at any price. The ships were enormously expensive in build, equipment and management; they never paid, even with the large subsidy granted, and collapse, under the circumstances, inevitably followed the heavy losses in ships at sea.

The Cunard line put afloat the Persia in 1855, and in 1862 the Scotia, paddle-ships of great size and power and both of iron. In the last named year was also built the China, the pioneer screw-ship of their present magnificent fleet, the last of which, the Servia, has a length of 530 feet, a beam of 52, a tonnage of 8500 tons, and a speed of 17½ knots. This is more than two and a half times the length of the first ships, fourteen times their registered tonnage and nearly eight times their gross tonnage; the first could carry but 225 tons of cargo, the last 6500 (the Bothnia and Scythia carry 3000); the first expended 4.7 lbs. of coal per indicated horse-power per hour, the latter ships but 2.2.*

* I regret that I cannot at this writing give the expenditure per H. P. of the Servia. It is, however, without doubt considerably less than that given (of the Bothnia, built

In the meantime other British companies had started and prospered. The Inman line was established in 1850, the Anchor line in 1856, the National line in 1863, the Guion line in the same year, and the White Star line in 1870.

Occasional American steamers made sporadic efforts to keep up a European intercourse, but in vain : our glory had departed. While these magnificent steamers were building we were still hammering away at our great wooden fleet, so soon to be extinct; building in 1853, 425,572 tons ; in 1855, 583,450 ; in 1857, 378,804, and in 1859, 156,602. A large portion of this tonnage was in ships, the numbers being:

In 1853, 269	ships	out of	a	total of	1710	vessels.
In 1855, 381	"	"	"	"	2024	"
In 1857, 257	"	"	"	"	1434	"
In 1859, 89	"	"	"	"	870	"

The Crimean war and Indian mutiny came to help our sailing fleet somewhat; we were still in 1856 carrying 75.2 per cent. of our exports, but from this time forth we fell off, and our ships had to seek business elsewhere. We had overbuilt enormously, a fact which we were beginning to find by 1856, as the above statistics show.

Consul Morse, in his interesting report to the Secretary of State, 1868, on the commercial policy of Great Britain,* states that of the large amount of American tonnage which arrived in England during the four years before the rebellion produced its effect upon our commerce, nearly fifty per cent. was in foreign employ.

Our total tonnage in 1861 was - - - - - -	5,539,813
That of Great Britain and dependencies, - - -	5,895,369
Mr. Morse estimates all others at - - - - -	5,800,767

Of these there were employed in the international carrying trade:

United States, - - - - - - - -	2,642,683
Great Britain, - - - - - - - -	3,179,628
All others, - - - - - - - - -	2,177,689
Total, - - - - - - - - -	8,000,000

in 1874); her expenditure of coal per day is 190 tons, with a speed of 16 knots, thus expending in a voyage about the same amount as the Scotia, whose average speed was at but 13 knots, under favorable circumstances, on 164 tons a day ; the latter, however, could carry but 1400 tons cargo and 240 passengers, against the Servia's 6500 tons of cargo, 450 first-class and 600 steerage passengers.

* House of Representatives, 40th Congress, 2d Session, Ex. Doc. No. 283

"Yet had all our export and import trade been done by her own ships, she (the United States) would have had a large surplus tonnage for an extensive foreign trade outside of her own territory and trade, because less than fifty per cent. (of her registered tonnage) could have done all her own foreign carrying trade. If trade had taken such a course," (*i. e.* had we done all our own carrying), "some 1,300,000 tons of American shipping would have been left in a trade with which the United States have no connection except as a carrier." I need hardly enter into the estimates by which Mr. Morse establishes his deductions; they are, however, perfectly clear and trustworthy, and any one can satisfy himself upon this point by turning to our Treasury Reports. Mr. Morse, in continuing, says: "An American ship coming to Europe takes an American cargo, or a cargo of deals from the British Provinces to some port in Europe. Such ships in a majority of cases obtain charters for long voyages, such as to India, China, or to some port in the Pacific, or elsewhere, and back to Europe. In this foreign trade American ships were often kept for years without once returning to the United States, because their owner found such employment more profitable than confining them to the short Atlantic voyage between Europe and America, even if our foreign trade was sufficient to afford business for all our tonnage at the same rates of freight."

The rebellion merely hastened an inevitable catastrophe in our shipping trade; during the few years of the war, 774,652 tons passed into foreign hands, and at the end we had 443,032 tons less in our total tonnage than at the beginning. In the meantime, foreign nations had been strengthening their steam connections. Brazil, the west coast of South America, and indeed nearly all parts of the world, had been brought into frequent and rapid communication with Europe by steamships. We had only been holding on to our sailing-ship trade, because steam even as yet was in a somewhat tentative stage, and there were many cargoes which could still be carried, and were carried years later, by sail instead of steam, from the mere fact that it cost 70 per cent. more per horse-power at the epoch of our civil war than it has cost in the last few years.

While England was building her present vast iron screw fleet, the Pacific Mail, the only important line of steamers left to us, was building wooden paddle-wheel ships; putting forth, from 1867 to 1870, the magnificent failures of the Alaska, China, America, Constitution, and Japan. There surely must be something peculiarly conservative in

the American character that has thus made us cling to the practice of almost the infancy of steam navigation. The British iron screws which were built at the same time, are many of them still in active service, while not one of the great wooden steamers I have named is in existence as a sea-going ship. In later years, the dearly bought lesson taught by the failure of these ships produced the present fine iron screw steamers of this line, but in building them we were only following in the footsteps of our great commercial rival, where we should have been equal to taking the initiative. The great advances in steamship practice have come not from us, but from the English and Scotch; how great these advances are has been already detailed, but will bear some reiteration. In 1840 the cargo capacity was but one-fifth the gross tonnage of the ship, to-day it is three-fourths; then the average speed was but 8.3 knots, to-day it is from 14 to 17; the expenditure per horse-power to-day is but 42 per cent. of that of 1840, but 51 per cent. of that of 1850, and but 54 per cent. of that of 1860. These wonderful changes have been brought about by energy and sheer ability, and I say honor to the men who have made them, whether Americans or Englishmen. There is nothing to be gained by depreciating an adversary's merits; an honest, straightforward recognition of an opponent's abilities is worth a great deal of self-laudation, in which we are too accustomed to indulge, and which goes but a little way towards building and operating steamships, and I see no reason for scant praise of such men even if it is at the expense of no small portion of our self-esteem.

The causes of British success, and our consequent decadence, may thus be summed up:

The elevation of the British shipmaster in intelligence, by requiring him to reach a certain standard and pass an examination before a certificate could be granted, by which he was put on an equal footing with our own.

The change in British models, in which they copied our clippers and made equally good passages—in these two changes thus giving their sailing fleet equal chances with our own.

The adoption of a most excellent Merchant Shipping Act.

The change from wood to iron.

The change from sail to steam.

To emphasize these there has been the fact of the existence of great and distant British colonies in every quarter of the globe,

with which quick and constant communication has been a necessity. Steam connections with India, the Cape of Good Hope, &c., have been imperative, and thus great steam lines have grown from social and governmental reasons which cannot exist for us. Still the British have successfully organized and operated great lines elsewhere, notably to the East and West coasts of South America, to which steamships than which there are none finer afloat are, and have for many years, been running with great frequency and regularity. I may say here that the establishment of the Pacific Steam Navigation Company, certainly in the number and character of the vessels of its fleet one of the finest in the world, was due to Mr. William Wheelwright, an American, at one time our Consul at Guayaquil, and for many years a notable and honored resident on the west coast. He sought aid in England after he was unsuccessful in his attempts to induce American capitalists to enter the field, and the result has been the monopoly of the great trade of Western South America. The time was then to secure the trade of this coast. The forty years' start in the race given England by the failure of our capitalists to listen to the wise words of Mr. Wheelwright, will hardly be recovered in this generation at least, let our efforts, diplomatic or otherwise, be what they may.

England has thus strongly established her mercantile influence in the most distant quarters of the world; her merchants have had a long and intimate knowledge of the requirements of various trades, and have entrenched themselves in a manner which will make dislodgement difficult, and our success, when it does come, can only come through steady, persistent and long-continued effort. It will not be the work of a day.

The question of relief is bound up in that of:

First, cheapening the cost of our ships.

Secondly, cheapening their running expenses.

There is nothing clearer than the fact that the merchant is going to send his cargo by the cheapest conveyance, safety and despatch being equally assured. We see quite as eager a competition for freights between British steam lines as we should see between British and American. Merchants do not do business for sentimental considerations, and there can be scarcely a doubt that the most patriotic of them would not hesitate to save a sixth of a penny a bushel freight on a cargo of wheat if he could do so by shipping it in a

trustworthy foreign steamer instead of in one under his own flag. This being the case, it seems axiomatic that the shipowner must be enabled to buy his ships as cheaply and operate them as cheaply as any of his rivals of equal reputation. The question thus becomes one of methods of bringing this about.

First, we must make up our minds that it is steam with which we must deal, and not sails. We have clung with a sort of desperation to hulls of wood, and to the wind as our motor; but the verdict of progress is against us, in spite of the pleasantly poetic words of Mr. Blaine, that "as long as wood grows and the winds blow, wooden sailing ships will be built"; true, no doubt, but they will not be the ships which will give us back our vanished prosperity on the sea, or enable us to meet on equal terms our rival who is strong in steamships. It is the story again of the stage-coach and the railway; the scene is but shifted from the land to the ocean.

Under our laws vessels are divided into two classes:

1st. The registered (employed in the foreign trade).

2d. The enrolled and licensed (employed in the coasting trade and fisheries).

No vessel can be registered, enrolled or licensed unless built wholly within the United States, or unless it has been captured in war, or forfeited for breach of United States laws, or unless she has been wrecked and afterwards purchased by a citizen of the United States, who in that case must satisfactorily show to the Secretary of the Treasury that the repairs put upon such vessel are equal to three-fourths the cost of the vessel when so repaired. (Sections 4132 and 4136, Revised Statutes of the United States.)

The vessel in all the above cases must be owned wholly by citizens of the United States. (Section 4132.)

All officers must be citizens of the United States. (Section 4131.)

The registry is invalidated if the owner or part owner usually resides abroad, unless he be a consular officer of the United States, or is a member of a house of trade consisting of citizens of the United States actually carrying on trade in the United States. (Section 4133.)

The registry is invalidated if the owner, being a naturalized citizen of the United States, resides for more than a year in the country from which he originated, or for more than two years in any foreign country, unless he be a consular officer of the United States. (Section 4135.)

No subject or citizen of any foreign power or State can be, directly or indirectly, by way of trust or confidence, or otherwise, interested in an American vessel or the profits thereof. (Section 4142.)

No American ship, once sold or transferred to a foreigner, can be brought again under the American flag. (Section 4165.)

No vessel under thirty tons can be used to import anything at any seaboard port. (Section 3095.)

If a vessel be repaired abroad, the cost of the repairs must be entered at the Custom House on her return to the United States, and a duty of fifty per cent. *ad valorem* must be paid. (Section 3114.)

All American vessels in foreign trade (vessels in the fisheries excepted) shall pay an annual tonnage tax of thirty cents a ton. (Section 4219.)

This is a short statement of the laws regulating the ownership, &c., of our shipping.

As it is a vital necessity to the American shipowner to build or buy as cheaply as his rival before he can fairly compete with him, one of the most serious questions in the consideration of the foregoing is whether the prohibition of buying abroad shall stand or not.

In sailing ships we are unquestionably underbid in cost of vessel by the builders of the British Provinces. A prominent shipowner in South street, New York, has lately informed me that he has just paid $58 per ton for a Maine-built ship; a larger ship sailed for California in November, 1881, launched in the same year, which cost a trifle under $50 per ton; either of these ships could have been built in 1879 for $47 to $48 per ton. A vessel of the same size as the first-named (1800 tons) has been lately built in Nova Scotia for $35 a ton. There is no doubt that either of the first-named ships is a better ship than the last, but this last ship will do the same work that the first-named will do, will be employed in the same trades, and get as large freights, though possibly she will not be insured at so low rates. But the Nova Scotian has cost but 66 per cent. of the cost of the American, and the American owner is certainly tremendously handicapped under such circumstances. The Englishman can sail his ship now with as few hands as we ourselves; double topsails and all other labor-saving appliances are quite as much affected in British ships as in our own; his wages are about the same. But both are surpassed in cheapness of ships and cost of sailing them by the numerous sailing fleets of Sweden and Norway. I have before me data from the Consul of these kingdoms at New York, which gives some interesting informa-

tion regarding their merchant service. I find that from fourteen to sixteen persons form the crew of a ship of 600 or 800 tons, the wages paid being as follows: Mate, from $15 to $20; seamen, $10 to $13; ordinary seamen, $8 to $10.

There were belonging to the two kingdoms in 1878,

18,595 sailing vessels with a tonnage of	1,929,641	tons.
1,058 steamers " " "	133,793	"
Total - - - - -	2,063,434	"

A tonnage slightly more than half our total tonnage, registered, enrolled and licensed.

We hear a good deal said of the scant food of foreign crews, but the annexed Swedish table compares very favorably with our own or any other. "For three alternate days during the week one and a half lbs. of salt meat and two-thirds of a pint of peas or small beans for soup, and for the remaining four days, three-fourths lb. of salt pork and one-sixth of a pint of groats with which to make soup, with onions or other vegetables. Every man also receives per week 8 lbs. bread, ½ lb. wheat flour, ¾ lb. butter or ½ pint olive oil, ⅛ pint of vinegar or ⅙ pint of lemon juice, ½ lb. of coffee (in the bean), 1 oz. tea, ¾ lb. sugar or 1 lb. syrup, ½ oz. mustard. When the vessel lies in port where fresh meat can be had, 1½ lbs. must be furnished at least twice a week instead of salt meat, for making soup with groats or vegetables. For cooking and drinking every man is entitled to at least one gallon of water daily.

"The master is responsible for the good quality of the food.

"Wine or other spirits cannot be claimed by the crew unless there is an express stipulation to that effect in the shipping articles; but if not furnished, each man receives Kr. 1.50 per month in lieu thereof."*

The northern nations of Europe are in their turn underbid by the Italians, who pay rather lower wages, and whose crews support themselves sometimes on an allowance of ten cents a day.

But the whole question of sail, and especially wooden sail, may be relegated to the background as a rapidly decreasing interest

* These ships are well officered; the nautical schools of Sweden and Norway for the merchant service antedate any others. All merchant officers must hold certificates, which are only granted after a rigid examination.

compared with steam, as is shown by the following changes in percentages carried by sail and steam:

		By sail.	By steam.
1850.	Per cent. carried, - - - -	86	14
1860.	" " - - - -	71	29
1870.	" " - - - -	57	43
1880.	" " - - - -	39	61

In 1870 Great Britain built 226,591 tons of steam against 136,286 tons of sail; in 1879, 297,720 tons of steam against 59,153 tons of sail;* the size and speed of steamers is constantly increasing, so that even for a given amount of tonnage, the disparity becomes greater year by year.†

Can we meet this necessity of using steam instead of sail by building iron or steel steamers as cheaply as the British? In November, 1880, at the sitting of the convention of shipowners, in Boston, Mr. John Roach stated that it would not cost more than ten per cent. to build here over the cost of England; so that this may be regarded as the minimum of difference. Wages have risen since, so that it can hardly be regarded as less than fifteen per cent. at present under the best circumstances.

I find in "Free Ships," by Captain John Codman, a note from one of the firm of Wm. Denny & Brothers, Scotch shipbuilders, the following prices given of transatlantic steamers:

2000 gross tons.	13	knots speed on trial, - - -	£ 44,000
3000 "	13¾	" " - - -	62,000
4000 "	14¾	" " - - -	96,000
5000 "	16	" " - - -	147,500

Mr. Stephen B. Packard, U. S. Consul at Liverpool, in his report to the Department of State, February 15, 1881, gives what are generally considered trustworthy estimates regarding British prices. He states that those ruling at that time for iron sailing ships of large

* The proportion has been even much greater in favor of steam in the past two years.

† Consul Brooks, of Cork, Nov. 5, 1880, says: In nine cases out of ten, American sailing vessels return home from Europe in ballast, as the westward bound steamers carry freight to America at so much lower rates than will pay the American vessels; the steamers calculating upon the freights from America to recoup them.

tonnage were $56 to $61.30 per ton, and gives the following table for steam:

Trade in which Employed.	Gross registered tonnage.	Horse Power.	Speed in knots.	Consumption of coal.	Price per ton in Dollars.
Atlantic, large cabin accommodation	8000	1400	18	120	$126 53
Ditto	5000	700	14	60	116 80
Atlantic, cargo	3600	400	12	35	97 33
Ditto	3600	300	10	28	77 86
General, cabin accommodation	2000	250	12	24	97 33
Cargo	2000	160	9	16	77 86
Cabin accommodation	1000	120	11	11	97 33
Cargo	1000	90	8	7	82 73

The first on the list would about represent the Servia, which at this rate would have cost $1,076,505. Mr. Packard has later stated that the above estimates have been carefully reconsidered, and he vouches for their accuracy, also "upon good authority it is stated that there are now contracted for in the United Kingdom, vessels to the aggregage of *650,000 tons*." *

I doubt very much if we can bring our rates within 10 or 15 per cent. of those given. I should think it very safe to say we cannot; but I think, on the broad basis of right, the shipowner should be allowed to buy his ship wherever he pleases. I can see no reason for ranking such property with obscene publications, as is now done under our law; these publications being the only articles which cannot be imported excepting ships. The right to lay a duty upon ships is clear; but the prohibition of the importation of such an article of merchandise is a violation of the rights of the citizen.

We have to-day in one of the steamships of the Pacific Mail Line at least one set of machinery of British manufacture. We can thus buy the engines, the iron for hull, the cordage, the masts, every item which is found in the construction and equipment of a ship, and in addition may import the labor to build her, but we cannot buy the ship as a whole. I can see in the law as it at present stands, nothing but a sentiment. At its foundation it was retaliatory, our commercial attitude towards England was one of well-founded bitterness, and I can only wonder that more extreme measures were not resorted

* More than five-sixths of this is steam, so that there are building (or contracted to build) more than four times our entire registered steam tonnage.

to than were. Down to 1849 our course was founded on the principle of absolute and perfect reciprocity; our laws of 1816–17–18 and later were only enacted with a purpose of obliging England to annul her absurd regulations regarding international traffic, but we seem to have lived under some parts of our first Navigation Acts so long that what was enacted as a temporary remedy has solidified into a general principle.

As the matter stands at present we have a coasting traffic entirely closed to foreign ships. The building and repairing of this shipping is entirely in our own hands. We are not building any steamers for foreign trade. Under any circumstances the occupation of our iron-shipbuilders would not be lessened by the introduction of registered foreign-built ships, so that the fear of the destruction of the shipbuilding knowledge and skill we now possess must be groundless. We are at the lowest ebb under our present system: why not at least try the other? It is at least worthy the effort.

The statute laying a tonnage tax of thirty cents a ton should be repealed: the $390,000 arising therefrom the United States can well spare; the shipowners cannot afford to pay it. In 1789 the tax as first laid was six cents a ton, and the present tax was instituted in 1862, when we had need to make use of every means of income. Massachusetts, New York, and Pennsylvania have abolished local taxation, thus taking off a great burden. English taxes are but from one to two per cent. on the profits, if any, and there is a small tax upon the premises occupied as offices, machine shops, &c. A ship owned in New York and valued at $100,000, would heretofore be assessed at 60 per cent. of her value, and pay a tax of 2½ per cent. upon this amount whether she made anything are not. The repeal by these great States, however, of this unjust discrimination in favor of foreign shipping is practically a repeal for the whole Union.

Section 4131, requiring that officers should be citizens of the United States, should be modified, as working at times great hardship through the impossibility of finding, in many cases of necessity, American citizens fitted to take the places of officers who have died or become incapacitated for duty. I can see no reason, should we ever establish a system of examination for certificates for the position of officer in our merchant marine, why we should not permit any one to take out such certificate whatever his nationality; following in this the example of England, who in her repeal of the navigation laws took this broad ground, with the result of attracting into her merchant

service many of our own best masters; and at least one of the largest British steamships now entering the port of New York is commanded by a man of American birth and citizenship.

Section 4578. "All masters of vessels belonging to citizens of the United States and bound to some port of the same are required to take such destitute seamen on board at the request of the consul . . . and transport them to the port in the United States to which such vessel may be bound, on such terms, not exceeding ten dollars for each person, as may be agreed upon between the master and consul. Every such master who refuses the same shall be liable to the United States in a penalty of $100 for each seaman so refused."

This section is so unjust upon its face that no comment is necessary. A reasonable and just compensation should be allowed. As it stands, the same amount would be paid for the transportation of a man from Havannah as from the Cape of Good Hope.

Section 4580. "Upon the application of any seaman to a consular officer for discharge, if it appears to such officer that he is entitled to his discharge under any Act of Congress or according to the general principles or usages of Maritime Law as recognized in the United States, the officer shall discharge such seaman, and shall require from the master of the vessel from which such discharge shall be made the payment of three months' extra wages over and above the wages which may then be due to such seaman." In case the cause of discharge is the misconduct of the seaman, part of this sum may be remitted.

Section 4582. "Whenever a vessel belonging to a citizen of the United States is sold in a foreign country and her company discharged, or when a seaman, a citizen of the United States, is, with his own consent, discharged in a foreign country, it shall be the duty of the master to produce to the consular officer the certificate list of his ship's company, and to pay to such consular officer for every seaman so discharged, designated on such list as a citizen of the United States, three months' pay over and above the wages which may then be due to such seaman."

These and Sections 4583, 4584 and 4585, so far as they relate to the payment of the extra three months' wages, should be modified. Chapter XIII, part III, of the British Merchant Shipping Act *

* The chapter referred to is, of course, too long for quotation, but the whole subject is placed therein on what seems an admirably fair basis. By this the

appears to cover admirably the whole ground of leaving seamen abroad, and we could not do better than adopt it as a base for a law upon this subject. There is no question that seamen should be carefully protected against the rapacity and abuse to which they are frequently subjected by shipmasters abroad. Cases wherein cruel treatment has been resorted to to force desertions and thus be free of the payment of wages due, or be clear of the expense of supporting an idle crew during a long stay in port, are but too well authenticated and have been too frequent; but by a careful revision of our laws and the establishment of a thoroughly sound consular system, we should be able to protect both the seaman and the owner. One case of which I know will serve to exhibit the unjust action of these laws. An American steamer, which had been for some time employed in the coastwise trade of Brazil, was to be taken to Montevideo to be sold; a crew was shipped with the express stipulation that they were to be discharged on arrival at Montevideo; the steamer arrived and was sold, but the consul refused to return the ship's register to the captain unless the three months' extra wages were paid. The case was finally adjusted after much difficulty, the fine of $2000 dollars to which the master was liable for non-delivery of the register to the Custom House of the port of registration being remitted under the circumstances.

Our consular system should be entirely remodeled.

I prefer that Mr. Blaine's impressions of the action of our consular service, in his letter to the Chamber of Commerce of the city of New York, in June 1880, should be given first instead of my own. He says: " After ships are launched and in trade, they should not be worried and harried and burdened with every form of taxation, port charge and quarantine exaction at home, *maltreated and oppressed as they too often are by our consuls in foreign ports.*"

I believe there has been no profounder abuse under our government than in our consular system. It has, in the words of Mr. Blaine, too often " maltreated and oppressed " our shipping interest, in a manner which has made it a wonder that our owners and merchants have not risen in a body and demanded of Congress an administration of its duties which would give them protection and aid instead of this "maltreatment" and "oppression."

master is obliged to obtain employment for the man in another vessel, or furnish him transportation home. The various conditions which may arise are fully treated in a manner which leaves little room for suggested improvement.

The consular tax upon shipping for the year ending June, 1880, was $592,161, and every penny of it came from our struggling ship-owners. The whole system is bad: the system of appointment, by which men utterly unfitted for such duties are sent abroad, and the system of taxation by which they are supported. I give a copy of fees charged, taken from a number of such bills before me, among which there is one which rises to $163.

February 5, 1879.

For Deposit and Delivery of Vessel's Papers.				
1 cent per ton on 726 tons,	$ 7 26	£1	10s.	2d.
For 11 seamen shipped, $2 each,	22 00	4	11	8
For 1 " discharged, 50 cts.,	50		2	1
For 1 declaration, 50 cts.	50		2	1
For 2 certificates, $2.00 each,	4 00		16	8
For judicial proceeding,	5 00	1	00	10
		£8	3s.	7d.

Notarial Services.	£	s.	d.			
To noting protests,		8s.	4d.			
Copy of contract,		10	6			
Copies of accounts,		4	2			
Acknowledgment of P. of A.,		8	4			
				1	11	4
				£9	14s.	11d.

The British charges are for certificate of entry, 1s. 6d.

For every seaman engaged or discharged, 2s.

Almost all the other fees are proportionately small, so that in general, consular fees for a British ship are but a small percentage of those paid by an American vessel in similar circumstances. The country can afford to pay its consular officers, and reduce their fees to a nominal sum; there should be no room for exactions of any kind, and finally, our consular system should be placed upon a footing of equality and respectability with that of any other country.

The establishment of training schools, especially for officers, is a necessity. All foreign nations have already done this; the schools of Norway, Sweden, Denmark and Hamburg dating back many years. Every port should have its "St. Mary's." The education of a man who is to command a ship costing perhaps a million, which may carry a cargo of two millions, and hundreds of valuable lives, is surely as important as the education of one in any other walk of life, and in these days he can no more be found made to hand than can the lawyer, the physician, or the statesman.

A rigid method of granting certificates should be established, which would ensure the capability of men serving as masters or mates. It could easily be arranged to place the examination of officers under the Navy, which has all the machinery for carrying such a law into effect without additional expense to the country. With the Naval Board there could be associated in each port where the board sits, an active or retired merchant-shipmaster as a member.

Much stress has been laid upon the merchant service as a reserve of seamen in case of war, but the value of such a reserve is becoming less and less as steam supplants sail. The Navy should rather serve as a training school for the better class of men in the merchant service in time of peace. England has for years educated from boyhood the seamen of her navy, and these men when they retire, as they usually do at 38, with a small pension, generally enter the merchant service, and form the most valuable class of petty officers in it, being trained to habits of discipline, &c., in a manner which could not be hoped for in any merchant marine training however efficient. The first naval reserve of England is her Coast Guard, likewise taken from the navy; our life-saving service should occupy a similar position here, giving a discipline and efficiency which it never can attain under its present system, making it a means of communication from sea with any part of the coast, and enabling vessels to ask or send information of any kind whatever. Organized as the English coast guard, its members should be taken from the most deserving of those who have served a sufficient length of time in the navy, revenue marine, or merchant service. This, while furnishing admirable means of communication between vessels and owners or consignees, serving as signal and life-saving stations, we should also have in addition a reserve of seamen sufficient to man a large fleet in event of war, and thus escape the immediate necessity of employing untrained men when trained are most needed.

Propositions have been made that vessels should be required to carry a given number of apprentices according to tonnage. I regard this as a mistake; they are a heavy tax upon the owner, render no adequate return for their pay and food, and would only add to the burdens under which we now labor. Training ships are our only resource for the early training of seamen. Apprenticeship has been a failure in England, and would surely be so here.

Admit all materials actually to be used in the construction and equipment of vessels free of duty.

I cannot think that we shall be able to build up a shipping trade by subsidies. A proper payment for the carriage of mails should be made; an equal rate for equal service performed being paid whether this service is on the sea or land. England paid for the year ending March 31, 1880, the following sums for the conveyance of mails by sea:

Brazil, River Plate and Chili, bi-monthly service from Southampton,*	£ 4,878
Fortnightly service from Liverpool,*	5,656
East Indies, China and Japan,	417,325
East Coast of Africa, Aden and Zanzibar,	10,000
Table Bay and Zanzibar,	20,000
North America, United States,	57,147
Halifax, Bermuda and St. Thomas,	17,500
Pacific,*	5,706
West Indies, bi-monthly service,	85,188
Non-contract service,	991
Additional service, Liverpool, Puerto Cabello, &c.,*	1,132
Belize and Jamaica,	3,500
Belize and New Orleans,	3,080
St. Kitts, Nevis and Montserrat,	490
Turk's Island and St. Thomas,	900
West Coast of Africa,*	7,863
	£640,797

If we paid a like sum as subsidies it would be equivalent to about $30 a ton on 100,000 tons of shipping, and then we should be supporting less than 5 per cent. of the steam tonnage of Great Britain. An analysis of the above table shows the extravagance of some of the statements lately made as to the subsidizing of steam lines by the British.

£5656 only were paid the Pacific Steam Navigation Company for fortnightly mails from Liverpool, touching at Bordeaux, Lisbon, Rio de Janeiro, Montevideo, Puntas Arenas and Valparaiso, extending by subsidiary steamers its service to every port on the Pacific coast north to Panama. Only £57,447 were paid for service to the United States, an amount which scarcely pays for the increased risk and trouble of calling at Queenstown.

£417,325 were paid for mail services to the East Indies, but no comparison can be drawn between this and any mail service which we are likely to establish, as it is not probable that we shall ever have

* The payments in these cases depended upon the amount of correspondence conveyed.

a great tributary empire such as that of the English in the East. Mr. Wetherill of Philadelphia said, in laying this statement of payments before the Boston convention of 1880, "England gives to-day as subsidies for foreign and colonial mail service £640,797, or an equivalent in our currency to $3,200,000. Now I put it to practical men in this convention, if I want to run in competition with an English line and get my vessels as cheap as English vessels, but the English line is subsidized so as to make a profit instead of a loss, how can I run and live?" [Applause.] How such remarks can be made and be applauded in the face of the above table I cannot understand. Less than *twenty-three cents* per ton (of shipping employed) was received by the Pacific Steam Navigation Company,* and not much more by the lines carrying British mails between Great Britain and New York.

I would ask, have subsidies built up the Anchor line, the National line, the Guion and White Star lines?

No, the impulse to build and operate steamships must come from within and not from without. It must have an incentive which has infected the whole commercial body of the country. We can never build up a carrying trade by supporting as a luxury, as a sort of sop to our vanity, a few steam lines which at best would be but a trifling percentage of the tonnage our commerce demands. It must have small beginnings, a foundation of general activity in the minor branches of the carrying trade, and the greater results will then soon follow. We must build from the bottom and not from the top.

I would thus state what in my judgment is primarily necessary to a revival of our shipping:

First. Permitting the person desiring to be a shipowner to purchase his vessel where it pleases him best to do so. I have passed over the frequent assertion that this would result in flooding our ports with broken-down British ships, as unworthy of notice: I still have a strong belief in the common-sense of my countrymen.

Secondly. A repeal of the tonnage tax, and of the laws mentioned relating to discharge, &c., of seamen.

Thirdly. The admission of all articles actually to be used in the construction and equipment of vessels, free of duty.

Fourthly. Establishing training schools for officers, and as many training schools for seamen as possible; combining with this a rigid

*This company owns 123,539 tons.

system of examination for certificates for all officers of merchant vessels.

Fifthly. An entire reconstruction of our consular system, making it equal to any; reducing fees and charges to a minimum, and not causing our shipping interest to support it.

Sixthly. The adoption of a maritime code on the basis of the British Merchant Shipping Act.

In addition to these, a tariff revision is an absolute necessity; having our ships, we must operate them as cheaply as others. There is quite as much competition between English lines leaving New York as there would be between an English and an American line, and our coal, our wages, our repairs, and all the expenses incidental to the management of a great steamship company must be no greater in our case than in the Englishman's. That this should be so requires that an amount of labor must be done by our workmen for the same pay equal to that which is done by the various classes of English laboring men employed on labor connected with steamships. Food here is cheaper; the English themselves grant that our men will do more in a given time than will their own; but it unquestionably costs more to live here in a given scale than it costs in England or Scotland. Our people must be enabled to live as well as they do now on a smaller wage, and the first step towards this is a change in our tariff.

We must wait too until capital finds less ready investment within our own borders. When our capitalists find that new railways no longer absorb their attention, when our internal communications are complete, our ocean trade will revive, and not before. Not enough stress has been laid upon the fact that the great West became a prominent field for the investment of capital about the time when our shipping was at its turning-point (1856). It has so continued; and so long as it thus remains, our shipping interest will be comparatively inert. We cannot do everything at once, and our hands have found enough to do in binding together the widely separated divisions of our great domain, and in giving the products of the most distant of our fields a way to the sea.

But under the best of circumstances we must not expect to instantly leap to the prominence of other days. Conditions have wonderfully changed; the capital needed is immensely greater. England has on hand immense plants for the building of hulls and machinery; has reared thousands of trained and skilled workmen;

her merchants have made complete and wonderful studies of foreign needs and tastes, and have acquired accurate knowledge of the necessities underlying any particular traffic; they have established their agencies in every port, and their steam lines reach every important seaport on the globe. Added to all this there is governmental administration of national mercantile affairs (by the Board of Trade), in marked contrast with our own absolute want of any system whatever; and a consular system which has aided in the work of the English merchant and shipowner, instead of hampering it, as has been too frequently the case in our own service.

It will take many years of earnest labor and judicious legislation before we can hope to compete on equal terms with British shipping and British merchants in the general trade of the world. We cannot hope to change the channels of traffic, which have had so long one direction, in a day.

NAVAL INSTITUTE, ANNAPOLIS, MD.

MARCH 9TH, 1882.

COMMANDER H. B. ROBESON in the Chair.

OUR MERCHANT MARINE: THE CAUSES OF ITS DECLINE, AND THE MEANS TO BE TAKEN FOR ITS REVIVAL.

By LIEUTENANT R. WAINWRIGHT, U. S. N.

Causa latet: vis est notissima.

That our merchant marine has declined is notorious, but the cause is hidden; at least, from the different remedies proposed, it may be supposed that the cause is not apparent to all. In order to trace the causes which have tended to produce the decline, it will be necessary to review somewhat the history of American shipping. Before the introduction of steam as the propelling power we had practically no rivals in shipbuilding, and England was our only rival in the carrying trade. In 1838 the Great Western made her first trip across the Atlantic, the first successful passage, under steam, across the ocean. From this time forward steam became of importance, until at the present time it has almost entirely superseded sail-power, except as an auxiliary. We were much slower than the English in adopting this method of propulsion for ocean vessels. In 1848 our steam shipping amounted to only 16,000 tons, but in 1851 we had nearly caught up to our rival, whose steam tonnage then amounted to 65,921 tons engaged in the foreign trade. This growth steadily continued until 1855, when our steam tonnage in the same trade amounted to 115,000 tons.

Then commenced the decline, which was slow at first, and in 1862 we had 114,000 tons. The decline in shipbuilding commenced about

the same time, as is shown by the decrease in the sales to foreigners, falling from 65,000 tons in 1855 to 17,000 in 1860. Next came the war, since which our shipbuilders have been mostly employed supplying the demands of our coasting trade; the sales to foreigners have been small, there have been built for our foreign trade but a few vessels, and these can hardly be called a paying investment to their owners. The Brazil line stopped with its subsidy. The Pacific Mail is in a most dubious condition, and the Pennsylvania line have not added to the original number of American-built vessels, but instead are using the Clyde-built steamers flying the English flag.

After the war commenced our shipping declined rapidly; many ships were destroyed by rebel cruisers, but many more were lost to us by whitewashing. Any flag was better than the "stars and stripes," and from 1862 to 1865 our loss by sales, real or pretended, amounted to 824,652 tons, or more than one-fourth of all the registered tonnage of the United States at the outbreak of the war.

In 1861 our entire tonnage was 5,539,813 tons, and in 1880 only 4,008,035 tons, a reduction of over 26 per cent., and this in spite of the enormous increase in our exports and imports. The following table shows the American and foreign tonnage entered at the ports of the United States from foreign countries in the following fiscal years, viz:

Year.	American tonnage.	Foreign tonnage.	American in excess.	Foreign in excess.
1830	967,227	131,900	835,327	
1860	5,921,285	2,353,911	3,567,374	
1863	4,614,698	2,640,378	1,974,320	
1864	3,066,434	3,471,219	...	404,785
1869	3,402,668	5,347,694	...	1,945,026
1876	4,711,940	12,218,365	...	7,506,425
1880	3,436,964	14,573,685	...	11,136,721

The following shows the percentage of decrease in our merchant marine, including registered, enrolled and licensed vessels. In 1876 the decrease was 11.83 per cent.; in 1877, 0.86; in 1878, 0.70; in 1879, 1.02, and in 1880 it was 2.43 per cent.

The following is the official statement of our merchant marine on June 30th, 1880:

Number of vessels registered,	2,378	
" " " enrolled	16,410	
" " " licensed	4,924	
Total number of vessels,	24,712	= 4,068,035.

Of these 4717 are steamers, 132 being registered; of the registered steamers, 44 are built of iron. Our once immense whaling fleet consists of 174 vessels = 38,408 tons.

For the year ending June 30th, 1880, the following is the report of vessels built:

Sailing vessels	460 = 590,571.9 tons,	1	of iron,
Steamers -	348 = 788,537.0 "	30	" "

of these eleven are ocean steamers.

All the authorities agree, and statistics show that our merchant marine engaged in foreign trade has greatly declined, and this in the face of an enormous increase in our exports and imports. Our commerce is very large but our carrying trade is very small. The statistics show that we first fell behind Great Britain after the successful introduction of steam, but soon overtook her again, and continued advancing until 1855, when commenced again a slow decrease, which continued until the outbreak of the rebellion. From this time until 1865 the decline was rapid, since then there have been slight increases, but terribly small in proportion to our commerce, and in the last few years there has been a decrease, and at an increasing rate, threatening a complete extinction of our foreign carrying trade.

PROGRESS OF BRITISH SHIPPING.

The *progress of British shipping* affords a sharp contrast to the above, and a useful lesson may be drawn from an account of it. The number and registered tonnage of vessels remaining on the register at the end of the year 1879 were as follows:

Number of steam vessels,	6,629;	tonnage,	2,733,269
" " sailing "	32,662;	"	5,729,095
Total,	39,291;		8,462,364

The greater effectiveness of British tonnage, arising from the rapid increase of steam vessels as compared with sailing vessels, is vividly shown in the table of entries and clearances. It appears that there was an increase of 2,173,000 tons in the entries, and of 1,652,000 tons in the clearances of British ships, and an increase of 368,000 tons in the entries, and 70,000 tons in the clearances of British sailing ships at ports in the United Kingdom in one year. On the other

hand, there was a decrease of 730,000 tons in the entries, and 834,000 tons in the clearances of foreign steamships at ports in the United Kingdom. The entries of British ships show an increase in tonnage of 3 per cent. and the clearances an increase of 2 per cent. over 1878; whereas the entries of foreign ships show a decline of over 3 per cent. and the clearances of over 7 per cent. as compared with the same year.

It appears that in 1860 the tonnage of the British Empire was 5,710,968 (sailing and steam), and the tonnage of the principal foreign maritime nations, excluding the river tonnage of the United States, was about 7,000,000 (sailing and steam). Allowing a steam ton to be equal in effectiveness to about four sailing tons, the tonnage of the British Empire was equal in effectiveness to 7,211,000 tons, whilst the tonnage of foreign countries was equal in effectiveness to 8,000,000.

In 1879, however, the tonnage of the British Empire was about 8,500,000, and the tonnage of the rest of the world was about 8,200,000. Allowing as before for the superior effectiveness of steam tonnage, it is found that the tonnage of the British Empire is equal in effectiveness to 16,000,000 tons, whilst the tonnage of the rest of the world is equal only to about 11 or 11½ million tons. In 1860 the tonnage of the British Empire represented about 47 per cent. of the tonnage of the world, and in 1879 it represented 58 per cent.

CAUSES OF THE DECLINE.

INTRODUCTION OF STEAM.

The first blow to our success was evidently the *introduction of steam* as a motive-power. The shipbuilders of Great Britain, struggling with difficulty to compete with our shipbuilders, seized upon steam as a means of advance. At first they were able to supply the workmen, while in America skilled labor was very scarce, but in ten years we had again caught up with Great Britain. But now steamship lines took the place of the old packet lines, and although more expensive to build and run, they were so much more effective as to be able to carry much greater quantities of freight for the same length of time.

IRON SHIPS.

In 1856 the second blow was felt by the growing demand for *iron ships*. Still this demand was not so pressing as to be injurious to

our carrying trade, and in 1862 we had only lost 1000 tons. But our shipbuilders felt it severely; the sales to foreigners declined very rapidly from 65,000 in 1855 to 17,000 in 1860. Here again the English shipbuilders got a good start, as they had both plenty of skilled workmen and cheap and accessible materials. The tables were turned on our shipbuilders, and now they had greater difficulties to strive against than the British formerly had been unable to overcome.

THE REBELLION.

Now came the crushing blow to our merchant marine, the *rebellion of the Southern States.* Our carrying trade was still large; we not only carried for ourselves, but for foreigners as well. Our navy was insignificant, and all its efforts were required to blockade the southern coast and to capture rebel ports. Our shipping was left unprotected, many vessels were captured, many destroyed, and large numbers changed their flag, so that the capital invested in them might be secure. Owing to this, we found at the close of the war that our foreign carrying-trade was nearly destroyed; not only that which we formerly carried for other nations, but even our own goods were carried in foreign bottoms. When the tonnage we had left came to compete again with that of foreigners in the general market, the vessels were found to be behind the age; the demand was for iron vessels; wooden ones found it hard to find cargoes and then only at very low freights, while at the same time they were more expensive to run than iron vessels. Our shipbuilders had either been without work or engaged building vessels for the government. The building of these makeshifts was of little aid in learning the problem of iron shipbuilding. While we had been perforce idle, the British had made immense strides, and to attempt to compete with them was almost, if not quite, impossible; also, a new building material had been introduced, mild steel was extensively used for ships, and at the end of the war we were without steel works.

THE NAVIGATION LAWS.

Now came into play with dire effect the *Navigation Laws.* These laws prevented the replacing of old types of vessels with new, as they forbid the American flag flying on foreign bottoms. Of these laws, Prof. Sumner says: "It is necessary, however, to go to Turkey or Russia to find instances of legislative and administrative abuses to

equal the existing laws and regulations of the United States about ships, the carrying trade, and foreign commerce. These laws have been brought to public attention again and again, but apparently with little effect in awakening popular attention, while the newspapers carry all over the country details about abuses in Ireland, Russia and South Africa. We should stop bragging about a free country, and about enlightened power of the people in a democratic republic to correct abuses, while laws remain which treat the buying, importing, and sailing of ships as pernicious, or at least doubtful and suspicious actions." The following are the more important of these laws.

Section 4131. Vessels registered pursuant to law, and no others, except such as shall be duly qualified, according to law, for carrying on the coasting trade and fisheries, or one of them, shall be deemed vessels of the United States, and entitled to the benefits and privileges appertaining to such vessels; but they shall not enjoy the same longer than they shall continue to be wholly owned by citizens and to be commanded by a citizen of the United States. And officers of vessels of the United States shall in all cases be citizens of the United States.

Section 4132. Vessels built within the United States, and belonging wholly to citizens thereof, and vessels which may be captured in war by citizens of the United States, and lawfully condemned as prize, or which may be adjudged to be forfeited for a breach of the laws of the United States, being wholly owned by citizens, and no others, may be registered as directed in the Title.

Section 4133. No vessel shall be entitled to be registered, or, if registered, to the benefits of registry, if owned in whole or in part by any citizen of the United States who usually resides in a foreign country, during the continuance of such residence, unless, etc.

Section 4134. No vessel shall be entitled to be registered as a vessel of the United States, or, if registered, to the benefits of registry, if owned in whole or in part by any person naturalized in the United States, and residing for more than one year in the country from which he originated, or for more than two years in any foreign country, unless, etc.

Section 4135. No vessel which has been recorded and registered as an American vessel of the United States, pursuant to law, and which was licensed or otherwise authorized to sail under any foreign flag, and to have the protection of any foreign government during

the existence of the rebellion, shall be deemed or registered as a vessel of the United States, etc.

Section 4136. The Secretary of the Treasury may issue a register or enrollment for any vessel built in a foreign country, whenever such vessel shall be wrecked in the United States and shall be purchased and repaired by a citizen of the United States, if it shall be proved to the satisfaction of the Secretary that the repairs put upon such vessel are equal to three-fourths of the cost of the vessel when so repaired.

Section 4142. This section contains the oath required from the owner before registration. This oath declares that everything is in conformity with the foregoing statutes. The final clause is worthy of notice: " That the person so swearing is a citizen of the United States, and that there is no subject or citizen of any foreign prince or state, directly or indirectly, by way of trust, confidence or otherwise, interested in such vessel, or in the profits or issues thereof, etc.

Section 4165. No vessel which is registered, pursuant to any law of the United States, and which is seized and captured and condemned, under the authority of any foreign power, or which by sale becomes the property of a foreigner, shall be entitled to or capable of receiving a new register, notwithstanding such vessel should afterward become American property ; but all such vessels shall be taken and considered, to all intents and purposes, as foreign vessels, etc.

Section 4172. If any vessel registered as a vessel of the United States shall be sold or transferred, in whole or in part, by way of trust, confidence, or otherwise, to a subject or citizen of any foreign prince or state, and such sale or transfer shall not be made known, as hereinbefore directed, such vessel, together with her tackle, apparel, and furniture, shall be forfeited, etc.

Section 4180. Every vessel built in the United States, and belonging wholly or in part to the subjects of foreign powers, in order to be entitled to the benefits of a ship built and recorded in the United States, shall be recorded in the office of the collector of the district in which such vessel was built in the manner following, etc.

There are three ways of recording vessels entitled to carry the American flag. By register the vessel is entitled to carry on the foreign trade. Vessels owned and officered by citizens of the United States and built there, or captured by citizens, or condemned for breach of law, or wrecked vessels on which the cost of the repairs

has amounted to three-fourths the value of the vessel, and no others, are entitled to register.

All vessels not registered, if above 20 tons, must be enrolled; the restrictions are the same as for a registered vessel. All vessels below 20 tons and all enrolled vessels carrying on the coasting trade are licensed. No foreign vessel can carry on the coasting trade, and trading between Atlantic and Pacific ports is considered as coming under the head of coasting. No enrolled or licensed vessel must visit a foreign port without special permission, nor can they carry on the foreign trade without being registered.

Nearly all the laws under Title XLVIII hamper our merchant marine. Some are injurious without any apparent excuse for their existence, such as those preventing the investment of foreign capital in American vessels. Others have been passed in order to benefit some other business; such as prohibiting the American flag to any but American-built ships. This was done in the interest of the ship-builders, and has aided in crushing them. Some are necessary for the prevention of attempts to defraud the revenue, and are necessary as long as we maintain a high tariff.

TAXATION.

The war severely stretched the purse-strings of the nation, and it was necessary to raise money by *taxation* in every direction. So the capital invested in shipping was taxed. The following are extracts from the Revised Statutes, showing the laws for this taxation:

Section 4219. Upon vessels which shall be entered in the United States from any foreign port or place there shall be paid duties as follows: On vessels built within the United States but belonging wholly or in part to subjects of foreign powers, at the rate of thirty cents per ton; on other vessels not of the United States, at the rate of fifty cents per ton. Upon every vessel not of the United States, which shall be entered in one district from another district, having on board goods, wares, or merchandise taken in one district to be delivered in another district, duties shall be paid at the rate of fifty cents per ton.* Nothing in this section shall be deemed in anywise to impair any rights or privileges which have been or may be acquired by any foreign nation under the laws and treaties of the United States relative to

* It is difficult to see the utility of this clause, as none but vessels of the United States can carry from coast port to port.

the duty of tonnage on vessels. On all foreign vessels which shall be entered in the United States from any foreign port or place, to and with which vessels of the United States are not ordinarily permitted to enter and trade, there shall be paid a duty at the rate of two dollars per ton; and none of the duties on tonnage above mentioned shall be levied on the vessels of any foreign nation if the President of the United States shall be satisfied that the discriminating or countervailing duties of such foreign nations, so far as they operate to the disadvantage of the United States, have been abolished.

In addition to the tonnage duty above imposed, there shall be paid a tax at the rate of thirty cents per ton, on vessels which shall be entered at any custom house within the United States from any foreign port or place; and any rights or privileges acquired by any foreign nation under the laws and treaties of the United States relative to the duty of tonnage on vessels shall not be impaired; and any vessel, any officer of which shall not be a citizen of the United States, shall pay a tax of fifty cents per ton.

Section 4220. No vessel belonging to any citizen of the United States, trading from one port of the United States to another port within the United States, or employed in the bank, whale, or other fisheries, shall be subject to tonnage tax or duty, if such vessel be licensed, registered or enrolled.

Section 4223. The tonnage duty imposed on all vessels engaged in foreign commerce shall be levied but once within one year, and when paid by such vessel, no further tonnage tax shall be collected within one year from the date of such payment. But this provision shall not extend to foreign vessels entered in the United States from any foreign port, to and with which vessels of the United States are not ordinarily permitted to enter and trade.

The above taxation falling at a time when the carrying trade had already received such severe blows, aided in the decline. State taxation is also a severe burden, but Pennsylvania extorts no tax, and there is a move to repeal such taxes in other States. There is also an indirect tax on shipping, in that certain articles which enter into the composition of ships are still taxed. The following sections show what articles are on the free list:

Section 2513. All lumber, timber, hemp, manila, and iron and steel rods, bars, spikes, nails and bolts, and copper and composition metal, which may be necessary for the construction and equipment of vessels built in the United States for the purpose of being employed

in the foreign trade, including the trade between the Atlantic and Pacific ports of the United States, and finished after the sixth day of June, eighteen hundred and seventy-two, may be imported in bond, under such regulations as the Secretary of the Treasury may prescribe; and, upon proof that such materials have been used for such purpose, no duties shall be paid thereon. But vessels receiving the benefit of this section shall not be allowed to engage in the coastwise trade of the United States more than two months in any one year, except upon the payment to the United States of the duties on which a rebate is herein allowed.

Section 2514. All articles of foreign production needed for the repair of American vessels engaged exclusively in foreign trade may be withdrawn from bonded warehouses free of duty, under such regulations as the Secretary of the Treasury may prescribe.

SUBSIDIES.

Great weight is given by all free ship advocates to the fact that our Atlantic steamship companies had failed before the outbreak of the war; from this they draw the conclusion that even then the high price of our ships had ruined the carrying trade. But have they been entirely fair in their arguments? As we had been so successful in steamships up to 1857, it is reasonable to suppose that their cost did not differ greatly from foreign steamers, nor was there much difference in the running expenses. Then, competing foreign lines had commenced to build iron steamers, but they had not been able to replace the wooden ones. So it was too early to expect that their introduction, at a much cheaper rate than we could hope to build for, should ruin our steamship companies. It seems as if some other cause must be sought, and subsidies seems to suit the case. With Great Britain's system of *subsidies*, our carrying trade was doomed to decrease, after the introduction of steam. It is doubtful if any fast mail lines have found steamers paying property, leaving subsidies out of consideration. In our present case the Pacific Mail seemed about to fail after the withdrawal of the subsidy, but much of the stock changed hands, the entire management was changed, and it is now run in the interest of a railroad company.

The Oriental and Occidental Steamship Company, chartering English steamers, is managed by the officials of the same railroad. This road can afford to run the steamers even if at a loss, as the railroad freights pay well. The same may be said for the Pennsyl-

vania Steamship Company. The Roach line to Brazil has been withdrawn lately, not being able to compete with English subsidized lines. While, if we had not forbidden the purchase of foreign ships, we could have struggled much longer; free ships alone would not have enabled us to compete against subsidized lines, but they might have allowed us to compete on routes not occupied by such lines, and to have opened new routes.

RESUMÉ.

The causes of the decline of our merchant marine may be summed up as follows: The introduction of steam as a motive power, the introduction of iron as the principal material for construction, the payment by Great Britain of large subsidies, the rebellion of the Southern States, the Navigation Laws, and taxation, both by the general government and by the States. The difficulties incurred in introducing steam were soon overcome; whether the difficulties of introducing iron would have been overcome at all it is not easy to say, for the war followed the introduction so closely that our shipbuilders had made no efforts; but it is possible that iron might have been as successfully introduced as steam if the conditions had remained the same. But during the hiatus caused by the war our shipyards were idle or building makeshifts for the government, and there was no chance for the gradual introduction of iron. At the close of the war iron had been well established as the best material, and the yards of Great Britain were supplying the immense demand. Then were felt in full force the Navigation Laws; the carrying trade was weak, and felt the effect of such laws as trammeled the traffic and inflicted taxation. And those laws which prevented our merchants purchasing foreign-built ships completed the ruin. Although our merchants could not have competed with the subsidized lines, they had many other accustomed channels open, which they might have continued to occupy had they been able to purchase iron steamers for a reasonable price.

MEANS TO BE TAKEN FOR ITS REVIVAL.

To revive our merchant marine it is necessary to make the carrying trade profitable to American merchants and to make ships valuable property to own,—property which is secure and returns a fair interest on the capital invested. How to do this is a very vexed question. The adherents of the different schemes may be arranged

on two sides: that of the Free Ships on the one hand and Subsidies on the other.

FREE SHIPS.

The followers of the doctrines of *free ships* are free traders, and are reinforced by most writers on political economy. The argument for free ships has all the weight of free trade at its back; and free trade in all things, or at least a tariff for revenue as against a tariff for protection, has been presented so strongly by all political economists since the time of Adam Smith, and the facts so fully prove the theory, that the only wonder is how it is possible that the people can take so long to learn a lesson so well taught. But this lesson of political economy is not the only one we refuse to learn, nor do we take advantage of the experience of others. Look at the system of sewerage in the national capital, where the plan of building immense sewers is being followed at an enormous expense, in spite of the fact that numerous cases in England have shown that large sewers are as unhealthy as they are expensive, and that small ones do their work properly where large ones fail.

David A. Wells has written one of the most exhaustive articles on Free Ships; in this he says: "If by reason of natural conditions and circumstances the exports and imports of the United States can be transported more cheaply and conveniently by the people and vessels of foreign countries than by our own people and vessels, it would be fighting against nature and a waste of resources to attempt to have it otherwise by paying subsidies, or what is the same thing, hiring people to do what naturally it is not for their interests to do. But if on the contrary our inability to compete with foreigners in the carrying trade of the ocean is the result of our own bad management and stupidity, then the failure so to do is such a loss of opportunity and waste of resources as would, if general, result in complete national impoverishment and decrepitude." And he shows very plainly that in his opinion it is the result "of our own bad management and stupidity," and makes out a fair case; but while he maintains the opinion, he fails to show that the repeal of the Navigation Laws and the free admissisn of foreign ships to American registry will re-establish our carrying trade. Prof. Sumner in a concise and lucid article in the North American Review lays down the dictum of Free Ships as governed by the laws of free trade. He says: "On the other hand, the emancipation of foreign commerce from all trammels of every sort is the only means of increasing the natural, normal,

and spontaneous support of carrying and shipbuilding, assuming that the carrying trade and shipbuilding are ends in themselves." Again, "I have said above that, if there were no restraints or interferences, we should simply notice whether any Americans took to the carrying trade or not, and should thence infer that they might or might not be better employed in some other industry. It is impossible now to say whether, if all restrictions were removed, the carrying trade or shipbuilding would be profitable industries in the United States or not. Any opinion given by anybody on that point is purely speculative." Again, "It is, however, no object at all for a country to have either shipbuilding industry, or carrying trade, or foreign commerce. Herein lies the fundamental fallacy of all the popular and congressional discussions about ships and commerce. It is only important that the whole population should be engaged in those industries which will pay the best under the circumstances of the country." Thus he thinks the only way to increase our marine is to repeal all the laws which trammel the carrying trade; but he is not by any means certain that this will accomplish the result, and furthermore he sees no object in attempting to increase our merchant marine. This is the extreme doctrine of those political economists who believe in a free government. They believe that most legislation is hurtful, and that none is right except such as is necessary to protect the citizens of a State from external and internal enemies, against foreign foes and domestic criminals; also any legislation which trammels one trade injures all. As to the necessity of a carrying trade, of shipbuilding, or of foreign commerce, Prof. Sumner would be undoubtedly right if the millennium had arrived, but for modern times the argument is too ethereal. As the present subject is really the carrying trade and only relates to shipbuilding and foreign commerce in so far as they affect the carrying trade, it will be necessary to show the desirability of increasing the former. A war always seems improbable until we are in the midst of one. Look at our late war; it was declared imminent many years before it came, and when it did come the great rebellion was looked upon as a trifling insurrection. A war with Great Britain seems improbable, but it is within the bounds of the possible. In the present state of the carrying trade it is hard to imagine how terrible would be the state of the country in case of such a war. It would be sufficiently unfortunate in any case, as are all wars, but as we now are it would be most disastrous. Look at our grain trade; not only would it lose

one market, but all markets would be cut off for want of vessels to do the carrying, for at the present time Great Britain has seven-eighths of that trade. Our grain trade has reached enormous proportions. Every day we hear of blockades at the great ports, elevators full, and long lines of heavily ladened cars lying idle waiting for storage room. The farmers could not sell their grain, railroads would lose freights, they would have less power to purchase, money would cease to circulate freely, and all business would be paralyzed at a time when the country most needed money. Furthermore, it is to our merchant marine that the navy must look for assistance in emergencies. Without a merchant marine, where could we look for seamen, for transports, for supply vessels? What would we have done in the late war without our merchant marine? Of course, if we have reached the millennium no navy is needed, either for attack or for defence. The adherents of subsidies are full of reasons for establishing a carrying trade, they flaunt patriotism in the face of their opponents, they quote the immense sums paid to foreigners for carrying our exports and imports, and declare this is theft from our own citizens. But these reasons are not sound. True, we pay immense sums to foreigners to do our carrying, but that is because it is cheaper to hire than to perform the work ourselves. The capital that would be required to do our own carrying brings a better return as it is employed, and more than balances the amount spent in hiring foreign bottoms. The real reason why it is important to establish a merchant marine is the necessity of providing for the occurrence of war. To provide reasonable security to our commerce against being overwhelmed and crushed by war is why we need ships flying the American flag.

Herbert Spencer, who is now at the head of all political economists, and who is a strong advocate of free government, even he says that it is admissible to protect certain branches of manufactures, etc., when necessary to encourage them for the protection of the state. Our commerce is strong enough to increase rapidly in spite of bad legislation; our shipbuilding is struggling along by the aid of our coasting trade, where foreign competition is forbidden, but our carrying trade is sick nigh unto death. Heroic measures are necessary for revival, and free ships alone will not effect a cure.

SUBSIDIES.

The followers of the doctrine of free ships have one great advantage on their side, they appear to be giving disinterested counsel;

but with those who follow *subsidies* there is always the appearance of interested motives, and often with good cause. Indeed, with us the trial of subsidies has been exceedingly unsuccessful. But has it ever been fairly tried? The amount of the subsidy has usually been small, and it has required each session of Congress great effort and expense to have the money granted. It is not possible to conduct business on a sound basis when such an important factor is doubtful.

The cause of the failure of our subsidized lines is that they have had to compete with lines already more highly subsidized, and with a country at their back ready to increase the amount if necessary. The repeal of the acts which prevent free trade in ships, in the materials which enter into their construction, and which impose taxation, would not allow the American capitalist to compete with the Europeans who have already large amounts invested in ships and are aided by their governments with large subsidies. We must subsidize American steamship lines.

The following shows the necessity of subsidies to British steamers which can be built so much more cheaply than our own. In a review by the Postmaster-General, Lord Montrose, upon the condition of the affairs of the Royal Mail S. S. Company, he expresses forcibly the absolute necessity of a subsidy for the maintenance of that company, as also the Peninsular and Oriental S. S. Company. He says, "In my report upon the accounts of the P. and O. Co., I showed that the revenue, exclusive of subsidy, which the company expected to earn in the performance of the services required from them, would cover only 85 per cent. of the expenditures proper to those services." "The actual revenue, exclusive of subsidy, of the R. M. Co , in the year 1864, the period of their greatest prosperity, amounted to 90 per cent. of their expenditures, but in the following year it fell to 85 per cent., and in the next to 79 per cent., whilst in the present year it will be barely 70 per cent. of their expenditure." * The following table will show what Great Britain is now doing to maintain her carrying trade.

* "Our Merchant Marine." C. S. Hill.

SUBSIDIES PAID BY GREAT BRITAIN FOR MARITIME MAIL SERVICES.*

Service.	*S. S. Co.*	*Subsidy per annum.*
Japan, China and India,	Peninsular and Oriental,	£ 450,000
Australian,	" "	130,000
Pacific,	Pacific Steam Navigation Co.,	15,896
South America,	" " " "	11,245
	Brazil and River Plate Co.,	2,140
	Royal Mail S. S. Co.,	33,500
West Indies, &c.,	" " " "	174,914
	Hamburg American, West India and Pacific,	11,173
	Cunard & Co.,	70,000
	Inman & Co.,	35,000
	North German Lloyd,	6,981
Africa, West Coast,	West African S. S. Co.,	9,335
Africa, East Coast,	Peninsular and Oriental,	30,000
Africa, Cape of Good Hope,	Union S. S. Co.,	28,000
British North America,	Montreal S. S. Co.,	24,375
Halifax, Bermuda & St. Thomas,	Cunard & Co.,	25,000
For the year 1877,	Total,	£1,057,559

Subsidies paid by the French Government for the same year amount to 23,388,892 francs.

The great trouble with those who argue for subsidies is their want of candor; they profess that they oppose the doctrine of free ships in the interest of shipbuilding when they really advocate subsidies in the interest of shipowners. They proclaim as a fact that ships can be built as cheaply in the United States as in Great Britain. Then why oppose free ships? Hill says: "Great Britain can no longer claim to be the cheapest ship market in the world. . . . The cost of English-built iron ships complete is £13 10s. to £14 per ton. The offer has been publicly made to build, in *this country*, ships of like specifications for the same amount currency, viz., $67.50 to $70 per ton, and *guarantee* an A 1 rate 20 years. In 1870 this could not be done, *but it can be to-day*." If we can build as well and cheaply as the English, which is better and cheaper than any other nation, free ships would not injure our shipbuilders. But this is not true. The Pennsylvania Co., which commenced with American-built steamers, is carrying much of its freight in English-built steamers. Mr. Hill says the cost of the necessary labor is from 50 to 60 per cent. of the entire cost of an iron steamer. Mr. Roach says it is about

* "Our Merchant Marine." C. S. Hill.

60 per cent. Mr. Roach, when interviewed on the occasion when he had trouble with his employés, produced a table from "Young's Labor in Europe and America" to show how much he had to struggle against, and it conclusively proves that it is impossible to build as cheaply in this country as in Great Britain under existing circumstances. The following is the table:

	United States.	England.
Shipyard Department.		
Shipsmiths,	$ 15 95	$ 6 05
Angle-iron Smiths,	13 20	6 29
Helpers,	8 80	3 75
Platers and Fitters,	13 20	6 40
Calkers,	9 35	5 32
Laborers,	7 70	3 38
Rivet boys,	3 30	1 69
Carpenters and Boatbuilders,	13 20	6 53
Joiners,	12 65	6 53
Painters,	12 10	7 32
Riggers,	11 00	6 20
Planers,	8 80	5 68
Punchers,	8 80	5 00
Riveters,	11 00	5 20
Steam Engine Department.		
Draftsmen,	19 80	8 22
Patternmakers,	14 30	6 41
Engine Blacksmiths,	13 20	6 59
Helpers,	8 80	3 87
Finishers,	13 20	5 86
Turners,	13 20	6 05
Planers,	13 20	6 25
Boiler Department.		
Fitters,	13 20	6 47
Riveters,	11 00	5 44
Calkers,	9 35	5 00
Holders on,	8 25	4 00
Laborers,	7 26	3 38
Boys, heaters and passers,	3 30	1 25
Flange Turners,	16 50	6 20
Iron Foundry.		
Loam Moulders,	16 50	6 50
Green-sand Moulders,	13 20	6 37
Melters,	13 20	6 00
Helpers,	7 70	4 00

Brass Foundry.

Brass Moulders,	$14 30	$6 15
Melters,	8 80	5 50
Chippers,	11 00	4 00
Laborers,	7 70	3 75
Total weekly wages, 36 men,	$ 406 01	$ 192 60
Weekly wages of 2000 men at same average	22,556 00	10,700 00

This shows that wages are over double as much in the United States as in Great Britain. Now even if the raw material is as cheap in our country as in Great Britain, a vessel there would cost about five-eighths what it would cost in this country. From a table in "Our Merchant Marine" can be seen what one American shipyard has accomplished. It shows that $14,000,000 were paid for labor and only $890,147 for material: a shipbuilder in Great Britain would have had to pay less than $7,000,000 for the same amount of labor.

Shipbuilding is so closely united with the carrying trade that it is hard to sever their interests; and as our carrying trade was strangled in the interest of the shipbuilders, so it has reacted on them, and would have entirely destroyed them but for our coasting trade. When it comes to the foreign trade, shipbuilders must give way, even if they consult only their own interests. There will be no foreign carrying trade unless our capitalists can buy ships as cheaply as those of other nations; and it would be better for the shipbuilders to have a carrying trade, even if all were foreign bottoms, for then they would have the repairs, and there would be a demand for their ships when labor became sufficiently cheap.

Some of the advocates of subsidies seem to think it possible to induce the people to think it to their advantage to pay large enough subsidies to enable steamship lines to be run with profit to their owners in spite of dear ships, in spite of present subsidies, and in spite of the increased subsidies, which would be given as soon as we attempted to compete.

Compromise.

There must be some *compromise* between the two factions, some ground upon which they can meet in common and both unite in order to influence legislation. Neither is strong enough to succeed alone. Most protectionists will oppose free ships, fearing that free trade in one article will only start the ball rolling toward free trade in all. Then there are those who, while not hoping for a general

scheme of subsidies, hope to get through their own little scheme and thus be personally benefited. There are also free traders who, while they argue for free ships only, hope to use it as an entering wedge.

While free trade may be most devoutly hoped for, the object of this essay is to show how the merchant marine may be increased, and it is hoped to draw that interest as much as possible from the clashing parties; not to put forward a scheme which would be adapted to the merchant marine under favorable circumstances, but what would best suit the existing state of affairs; in other words, a practicable scheme. The great danger of a compromise is that it suits neither side, yet all legislation of the present day is the result of a compromise, and however strong and eager the advocates of any scheme may be, they must yield somewhat to their opponents, or there will be a deadlock, then a compromise is adopted and becomes the subject of abuse for all parties.

As the French have been wisely striving to increase their carrying trade, also their shipbuilding interests, something may be gained by looking at some new laws intended to promote those interests. These laws are in addition to a subsidy already quite heavy.

The French Mercantile Marine Bill.

Article 1. The right of free pilotage is granted to all sailing vessels not measuring over 80 tons, and to steamers whose measurement does not exceed 100 tons, whenever they run regularly between port and port, and habitually frequent the entrances to rivers.

Nevertheless, at the request of the chamber of commerce, and after an inquiry in the usual form has been made, the public administrative regulations shall determine the modifications of rules which may be considered necessary in the interest of navigation.

Art. 2. For foreign-going vessels the visit of inspection prescribed by Article 225 of the Commercial Code for a fresh cargo loaded in France shall not be obligatory unless six months have elapsed since the last inspection, except the vessel may have sustained damage.

Art. 3. For the official documents or procès-verbaux, showing the changes of owners of the ship, either totally or partially, a fixed charge shall be made for registration of 5 francs. Article 5, No. 2, of the law of the 28th February, 1872, is repealed so far as it is contrary to the present provision.

Art. 4. To compensate shipbuilders for the charges fixed by the custom-house tariff, the following allowances shall be made them:

For gross tonnage: For iron or steel vessels, 60 francs; for wooden vessels of 200 tons or more, 20 francs; for wooden vessels of less than 200 tons, 10 francs; for composite vessels, 40 francs; for engines placed on board steamers, and for auxiliary apparatus, such as steam pumps, donkey engines, winches, ventilators worked by machinery, also boilers and connecting pipes, 12 francs per 100 kilog.

Ships planked with timber, having beams and ribs of iron or steel, are to be considered as composite vessels.

Art. 5. Every change in a ship by which an increase in measurement is gained shall give right to a bounty, based on the above tariff, according to the increase of tonnage gained. A similar bounty shall be granted for driving engines and auxiliary apparatus placed on board after completion of the ship.

On change of boilers the owner shall be allowed a compensation allowance of 8 francs per 100 kilog. on new boilers without the tubes, if of French make.

Art. 6. The fees granted by Articles 4 and 5 shall be paid on delivery of the ship's register by the receiver of customs at the port nearest to the place of construction.

Art. 7. The regulation of admission in bond fixed by Article 1 of the law of the 19th May, 1816, and by Article 2 of the law of the 17th May, 1879, is abolished.

Art. 8. Shipbuilders shall receive allowances for vessels on the stocks at the time when the present laws shall come into force, as stipulated in Articles 4 and 5, after deducting the amount of custom dues fixed by the conventional tariff on foreign imports which may have been entered in bond for shipbuilding purposes.

Art. 9. As compensation for charges imposed on the mercantile navy for recruiting and the military navy, a navigation bounty shall be granted, during ten years from the date of publication of this law, to all French vessels, sailing or steam.

This bounty is applicable only to foreign-going vessels.

It is fixed at 1 franc 50 centimes per register ton and per 1000 miles run for vessels fresh off the stocks, and decreases annually by 0.075 franc for wooden vessels, 0.075 franc for composite vessels, 0.05 franc for iron vessels.

This bounty is increased by 15 per cent. for steamers built in France according to plans approved of by the marine department.

The number of miles run is calculated according to the distance from the point of departure to the point of arrival, measured on a direct maritime line.

In case of war, merchant ships can be requisitioned by the State.

Vessels used for fishing, those belonging to subsidized lines, and yachts, are excepted from receiving a bounty.

Twenty per cent. from the bounty granted by the present law shall be deducted and paid into the "Caisse des Invalides" of the marine, so as to increase the retiring pensions of registered seamen.

Art. 10. Every master of a vessel receiving a bounty fixed by Article 9 of the present law shall be obliged to carry, free of charge, mails put under his charge by the post-office authorities, or which he will deliver to their administration, as prescribed in the consular decrees of the 19th Germinal, year X.

If a post-office agent is deputed to accompany the despatches, he shall also be conveyed free of charge.

Art. 11. A regulation of public administration, containing a special statement of the distance between ports, shall fix the system on which this law shall be applied.

The above bill has already passed the Chamber of Deputies, and is now undergoing examination in the Senate.

Resumé of the laws and regulations governing owners or part owners of foreign-built ships in France, which shows the privileges granted to the most favored nations.

Naturalization of Merchant Vessels purchased in Foreign Ports.

Sea-going vessels purchased in foreign ports, one-half of which at least is owned by French citizens, may be permitted to sail under the French flag. They must first pay the following duties:

1. The Import Duty, which is payable to the custom house.

2. The Transfer Duty, which is payable at the registration office.

1. IMPORT DUTY—This duty differs according as vessels are admissible at the rates fixed by conventional tariffs or are subject to those of the general tariff.

Conventional Tariff.—Sea-going vessels are obliged to pay, according to the conventional tariffs, 2 francs per ton of their

actual capacity (no deduction being made for the space occupied by machinery, coal, sleeping apartments of crew, &c.) Vessels are measured by the English method known as the Moorsom method. For the conventional tariffs to be applicable the vessel must have been built in one of the European states with which treaties of commerce have been concluded since 1860; since they were launched, moreover, such vessels must not have ceased to carry either the flag of the country in which they were built, or that of some other contracting European state. The contracting European states are England, Belgium, Italy, Switzerland, Sweden and Norway, the Netherlands, Portugal, Austria, Germany, Turkey, Russia and Spain.

General Tariff.—According to the general tariff, sea-going vessels are obliged to pay the following dues: Vessels of wood, 40 francs per ton of actual capacity, plus 4 per cent. Vessels of wood and iron, 50 francs additional, according to the law of December 30, 1873. Vessels of iron, 60 francs additional, according to the law of December 30, 1873. All vessels built in non-European countries are obliged to pay the above dues, especially those from the *United States* and the British colonies, including Candaa; also vessels built in European countries not included in the above list.

2. TRANSFER DUTY.—According to the law now in force, which bears date February 23, 1872, any sale of vessels either in whole or in part, is subject to a transfer duty of 2 per cent. of the value (plus the additional two decimes and the half decime.) This duty is payable both on purchases made in France and on those made in foreign ports. The custom house will not grant permission for a vessel to sail under the French flag until evidence has been furnished that the transfer duty has been regularly paid. But one exception is made to this rule, and that is in the case of a new vessel built in France or in a foreign country for the account of the person who applies for its registration in his own name.

Vessels purchased in foreign countries with a view to obtaining permission for them to sail under the French flag may be authorized by French consuls to carry the French flag temporarily, after evidence has been furnished that they have been actually purchased. To this end our consuls issue certificates to captains, which entitle their vessels and cargoes to the same usage on their arrival in a French port that is accorded to French vessels and cargoes.

The naturalization duty is as follows:

Tonnage.		Amount of Duty.
Less than 100 tons,	.	10$\frac{4}{5}$ centimes per ton.
From 100 to 200 tons,	.	21 fr. 60 cent. per vessel.
" 200 " 300 "	.	28 " 80 " " "
300 tons and upward,	.	28 " 80 " " " and 7 fr. 20 cent. for each additional 100 tons.

Any fraction of 100 tons is considered as 100 tons.

These regulations and laws are very enlightened in comparison with ours, but it will be necessary for us to be even more liberal.

We must repeal all the laws governing the registration of vessels, and in lieu enact laws similar to the following:

1. Vessels registered pursuant to law, and such as shall be duly qualified according to law for carrying on the coasting trade and fisheries, or one of them, shall be deemed vessels of the United States, and entitled to the benefits and privileges appertaining to such vessels; but they shall not enjoy the same longer than they continue to be wholly officered by citizens of the United States.

2. Any and all vessels wholly officered by citizens of the United States may be registered as directed in this title.

Also, such laws as are necessary for carrying out the above.

This would be a concession by the protectionists, but it is necessary, and would assist instead of injuring shipbuilders. The officers are required to be citizens because it is necessary for the safety of the state to encourage this class, and would ensure the vessels remaining under the flag as long as properly protected.

Retain the law requiring all enrolled and licensed vessels to be built in the United States, and allow them the privileges of registered vessels after giving such notification as is necessary to prevent smuggling. The retention of this law is necessary for the protection of shipbuilding, and the protection of shipbuilding is necessary to the safety of the state. Moreover, experience shows that the saying of Mr. Roach, "that no country can have a large carrying trade which has not a large shipbuilding interest," is true.

Repeal all laws for state taxation, and remit the taxation imposed by the general government to all vessels carrying the American flag.

Encourage shipbuilding by bounties, as in the proposed French laws.

Now come subsidies. It is not meant to recommend subsidies as heretofore granted; nothing could be more ruinous, nothing more demoralizing. An ample scheme of subsidies is necessary, which shall be given, as far as possible, where it will benefit public and not private ends. It need not take the form of a direct gift, but may be a guarantee of a certain percentage on the capital invested. Let the routes which will have subsidized lines be few at first, to be gradually enlarged in number as the success of the plan is proven; try only one or two lines, but let the subsidy be sufficient and certain.

It would be almost madness to try to establish more Atlantic lines at present; except possibly one from Savannah or some other Southern port, where a direct line to England, carrying cotton, etc., and bringing back European manufactures, might be successful with a reasonable subsidy. But lines to Mexico, Central America, and especially South American ports, might be made a success. There would be less opposition to encounter on such lines, there are demands for vessels from these ports, and our general policy of maintaining our supremacy on this continent would be greatly aided by such lines. Now these lines might be made to pay pecuniarily, as well as be according to the dictates of a sound policy, by the increased receipts from custom dues. In the case of the Pacific Mail, the increased revenue from 1867 to June 30th, 1876, was about $1,500,000 over and above the subsidy, and the actual gain in wealth to the United States by increased trade was enormous. On certain lines which should be approved of beforehand the government should guarantee a certain per cent. on the capital invested, until such a time as the government inspector should find that the receipts of the line were sufficient to pay the necessary interest. The amount of interest should be fixed by a sliding scale, dependent upon the earnings of the company and the ruling rate of interest for that time. This would be a less dangerous and more economical form of subsidy than giving it in a lump sum. As such lines were found to reimburse the government by increased revenue, new lines could be started until our carrying trade bore a just proportion to our needs, and we were placed in a reasonably safe condition in case of war. That there are ports where American lines would greatly advance American business and commerce is conclusively shown by the consular reports, from various portions of the globe, published in "The Commercial Relations of the United States."

There must be made another concession in the direction of free trade, and that is in the tariff laws. For against the products of many American states our tariff amounts to prohibition, and in most cases it protects very small interests and benefits only a few men. But all who coin money by our tariff system, a system of protection for the few at the expense of the many, are united by their interests, which are plain and manifest; while those who are injured are affected more indirectly, and are hard to unite on any plan. Still the country is becoming rapidly educated in the laws and advantages of free trade, and concessions must soon be made. The cry for a revision of the tariff is becoming so strong that the laws will be revised, and although it may be long before we can have a tariff for revenue only, steps will be taken in that direction, a compromise will be effected.

Commissioner of Commerce.

To regulate the varied affairs of commerce, the carrying trade, and shipbuilding, an executive head will be required, with the necessary force under his control. A *Commissioner of Commerce* will be needed, to see that the laws are carried into effect, to note their operation and to recommend changes. And it may be hoped that under intelligent direction the various branches will become so important as to justify the bureau under his direction being erected into a department. For the present there is a good nucleus for such a Bureau in the Treasury Department, where all the statistics regarding our commerce, etc., are gathered and the present navigation laws administered. But the work needs to be gathered from the different bureaux among which it is now distributed, and placed under one head, so that some definite plan of action may be carried out; and there is needed the same partial independence as is held by the Commissioners of Patents, Agriculture, etc.

By collecting his data he will be able to recommend where the subsidies are to be placed, how much money will be needed, etc.

Our Navy.

But what will avail all these inducements if our government cannot guarantee ample protection to the capital invested; and how can such a guarantee be maintained without a decent naval force? Of course if we are to have no wars we need but few vessels to fulfil the duties of peace. But the belief in universal peace is not strong

enough to induce capitalists to risk their money without some show of protection. At present the only security to our flag when flown abroad, is the absence of desire or interest to offend. The small empire of Japan has a navy with which ours is unworthy of comparison.

In our late rebellion the want of adequate protection was severely felt, and a blow was dealt, by a few light cruisers, to our merchant marine from which it has never recovered. But during this war we showed a facility in raising a naval force which has served to lull the country into fancied security. This feeling of security has been maintained until quite recently by reports of increased efficiency, the untruth of which was more apparent to the naval officer than to the general public.

Modern warfare afloat can no longer be conducted as of old, where courage and daring could supply the lack of power. What courage would enable the wooden vessel to stand up against one heavily armored? Or how would daring avail in a slow steamer? Many are now of the opinion that we have nearly reached a period analogous to that when land troops threw off their armor, and that guns will so far surpass armor that it will only be an unnecessary burden. But whether we fight at sea with armored or unarmored vessels, we must use all modern appliances. A man-of-war requires time and money for building, and the necessary plant cannot be supplied rapidly under the pressure of necessity. A vessel-of-war has become a scientific instrument, and requires intimate knowledge of all its parts for successful handling.

While in theoretical knowledge our officers are second to none, and are ahead of most, in practical knowledge they are far behind many. In fleet tactics they have had no experience since that motley crowd of vessels were assembled at Key West, and the experience there gained was about as useful as the experience of a raftsman would be to the master of a large ocean steamer. Of fleet tactics, ramming tactics, helm angle, etc., our officers have no practical experience.

Our ram and torpedo boat has just been successfully repaired, and she can now make the wonderful speed of eleven knots, so that if she can only find, in case of war, some of the enemy who have, by accident, been reduced to that speed she will no doubt be able to do great execution. No doubt she has spread her fame abroad and thus added greatly to the protection afforded by the American flag.

Property on water is like property on land, its value deteriorates or enhances in proportion to its security. And even with subsidies the profits are not large enough to induce capitalists to invest, if insecure, even when speculative mania is abroad and almost any scheme can draw money from the speculator.

The navy and the merchant marine must go hand in hand. Whatever capital is invested in shipping becomes interested in the navy, and without such an interest being created, adequate appropriations for a naval force cannot be obtained.

Even with our present small merchant marine the want of proper protection has been felt. The flag of the United States has been insulted by Spain, and there was not sufficient force to avenge the insult. With a stronger force our policy might have been stronger. The show of force we then made was a balloon which *may* have deceived the Spaniards, but which would have been punctured by the first rifle-shot fired.

There is an apparent awakening to the condition and needs of our navy. A board of naval officers has been ordered, and is deliberating upon a plan for building up a navy commensurate to our wants. May this augur well for our merchant marine! This plan being approved by the Secretary of the Navy, and urged by him upon Congress, the necessary funds may be obtained for building up a nucleus for our navy of the future; and when the foreign carrying trade assumes its just proportions, the navy growing with it will be able to protect it from foreign aggression, as well as to extend it the hand of brotherly aid in all portions of the globe where commerce may call, and American enterprise send, the Stars and Stripes.

The new vessels which must be built will afford encouragement and assistance to our shipbuilders, and thus indirectly assist our carrying trade.

The Nicaragua Canal.

The mass of our Eastern States are destined to become great in manufactures. Even now, the Southeastern, having somewhat recovered from the effects of slave labor, are raising large manufacturing establishments. The State of Georgia has made immense strides since the war. Our Northeastern States have long been centres of manufacturing industry.

The Pacific slope is an immense grain-field, and adding to its acres under culture every day in the Northwest. For a free exchange

of commodities between the two slopes a shorter water route is needed. Freights by land are too expensive for the more bulky articles. A canal connecting the two oceans would give great impetus to trade between the two slopes, and would not injure the railroads, which on the contrary would share in the increase of business due to increased prosperity. Of course, as far as our carrying trade is concerned any other route than the Nicaraguan will do, provided such route can be used for the purpose; but so far as our present information goes (and it does not appear as if further information would give different results), the Nicaraguan Canal is the only feasible scheme. It has little to fear from such visionary schemes as De Lessep's sea-level canal or Eads' ship railway; they may draw away money which would otherwise be invested in the Nicaraguan Canal, but they will fall to the ground when actually attempted!

This canal will also open out a large trade with the western coast of Mexico, Central and South America. As the trade between our Eastern and Western coasts must be carried on in enrolled vessels, there will be a large demand for American-built steamers. May our shipbuilders be ready and able to supply this demand.

Compulsory Pilotage.

The various laws of *compulsory pilotage* are a severe tax on any regular line of vessels, as they are required either to take a pilot or pay half pilotage, when in most cases the master of the vessel is able to perform all the duties required of a pilot. It is an unjust tax on the commerce and shipping of the country. Why should this body of men require special protection? It would be as just, and far more beneficial, to tax them for the support of dockyards and require them to use and pay for the docks or pay half dockage fees. The supply of pilots will equal the demand if not interfered with by laws, and the owners may be left safely to consider the security of their property and employ pilots where and when necessary. There are few of our ports where the master of a steamship would not soon be able to take his vessel in and out with safety. With sailing vessels it is different; when obliged to beat up the channel the ranges must be well known, every foot of ground and all the currents familiar. The legality of these State laws is doubtful; they appear to conflict with the constitutional power of Congress to regulate all affairs of commerce, both foreign and between States.

Our Diplomatic and Consular Service.

Any improvement in *our diplomatic and consular service* would be an aid to our commerce and carrying trade. But if they were formed into a permanent corps somewhat upon the model of Great Britain's service, it would be of great assistance. Even now the reports of Consuls and Commercial Agents are of considerable value; but how much more valuable would they be if they had some certainty of tenure of office, and if the excellence of their reports were a test of their fitness for promotion. How carefully would every chance of increasing our commerce be watched, and every means of aiding our marine be seized.

Our only foreign policy is embodied in the so-called "Monroe doctrine," therefore our diplomats have little else to do besides look after our commercial interests and seek after favorable opportunities for advantageous treaties. So let them be men who are familiar with our commercial and shipping interests. In those ports where our Ministers and Consuls have ex-territorial jurisdiction it is necessary to have lawyers, but they can look after our other interests as well, if sufficient inducements are held forth.

Résumé.

The principal means, then, to be taken for the revival of our merchant marine are: first, the alteration of the Navigation Laws so as to admit any vessel to American register. To allow any one to invest his money in shipping. To allow an American-built registered vessel all the privileges of a licensed or enrolled vessel. To remit the tonnage tax, repeal the laws for State taxation, and compulsory pilotage laws. To pass a comprehensive scheme of subsidies. To place the three interests, so closely bound together that it is almost impossible to treat of them separately, commerce, the carrying trade, and shipbuilding, under a Commissioner of Commerce. And to build a navy that will guarantee protection to the capital now invested, and to build it on such a basis that it may grow with the merchant marine, and render certain the carrying of our flag secure and honorable in all portions of the navigable waters of the globe.

NAVAL INSTITUTE, ANNAPOLIS, MD.

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COMMANDER H. B. ROBESON in the Chair.

OUR MERCHANT MARINE: THE CAUSES OF ITS DECLINE, AND THE MEANS TO BE TAKEN FOR ITS REVIVAL.

By ENSIGN W. G. DAVID, U. S. N.

Tempori parendum.

HISTORICAL.

In order to understand the causes of the decay of American shipping and to suggest remedies for its revival, a brief review of the rise and fall of the great maritime nations of the past will be necessary.

The Phœnicians were the first of the nations of antiquity to make the sea their domain, and their chief cities, Tyre and Sidon, were early famous for a regal pomp and magnificence that was provided with the riches their ships brought from every quarter of the known world. "Tyrian purple" was appropriately emblematic of the splendor that reigned in Phœnicia during her commercial and maritime greatness. The rise of Phœnician shipping may be assigned to the following causes, viz: 1. To her extended sea-coast and good harbors. Phœnicia was a long narrow strip, in only a few places reaching back as far as twelve miles from the coast, but stretching out to the north and south for nearly two hundred miles. Thus all Phœnicians were, of necessity, well acquainted with the sea and with ships. 2. To her geographical position. Situated midway between the old civilization of the East and the growing wants of the West, she was naturally the medium through which were exchanged

the luxuries and manufactures of the one for the raw products of the other. 3. To her wise policy. She was perfectly willing to trade with anybody, but unwilling to have anybody compete with her ships, and, therefore, did everything possible to increase and foster her own shipping and to ruin that of any rivals. 4. To the fact that ship-building materials were abundant and cheap, and that she therefore built her own ships. 5. To her strong navy, without which, having attained to any maritime greatness, she must quickly have fallen a prey to some more far-sighted power. At the time of her greatness she was the first naval as well as the greatest commercial power of the world. 6. To her numerous and rich colonies, that, though doubtless a consequence of her maritime enterprise, were greatly instrumental in augmenting the force that had created them.

Tyre continued to enjoy the most wonderful prosperity down to the time of Alexander, when it was completely destroyed by that murderer of nations. The foundation of Alexandria and the consequent diverting of trade into new channels, rendered vain all her attempts to regain any portion of her old power. For a number of years after the destruction of Tyre the seaports of Greece monopolized the trade of the Mediterranean, Rhodes being probably foremost among them.

A great change was now taking place in the affairs of the world; the centre of civilization was making a voyage to the westward, and with it travelled empire and trade. Carthage, the most vigorous of the Phœnician colonies, inheriting that aptitude for the sea and that commercial enterprise that had made her founders so pre-eminent, found herself in a position to take immediate advantage of this change of affairs. Situated as she was, near the centre of the southern shore of the Mediterranean at its narrowest part, having on her right the old civilization of the East; north of her Rome, with no knowledge of ships and no heritage of nautical skill, but with rapidly increasing demands for luxuries that could only come to her by water; and to the west and south the almost limitless possibilities of new and barbarous countries, Carthage quickly equalled and at length completely outstripped all rivals in the value and extent of her commerce and shipping. France shows to-day, by her seizure of Tunis, her appreciation of the great strategic and commercial advantages of the site of Carthage.

The pre-eminence of Carthaginian shipping was due to exactly the same causes as that of Phœnicia had been. She had good harbors

and an admirable position between producers and consumers. She pursued a policy eminently calculated to the maintenance of the supremacy that she was able to achieve when she had no aggressive rivals, making several commercial treaties with Rome that permitted comparative freedom of intercourse with herself, but keeping her colonies closed to all foreign trade; she encouraged shipbuilding so that her shipwrights soon became famous for their skill, and were able to build ships cheaply and well; she founded numerous colonies, and instituted and fostered a navy whose growth was commensurate with that of her merchant shipping, so that when Carthage was the greatest commercial power, she was, like Tyre before her, "queen of the waters."

Rome seems to have made no attempt at the commerce of the seas until forced to it by the great power of Carthage. Indeed, a very strong prejudice existed in Rome against trade, and against sailors as instruments of trade, which was probably in part, if not wholly, due to an old law that forbade senators to own ships lest they should become rich and neglect their duties to the state. These prejudices, however, gradually died out, and as Rome's geographical position was as favorable as that of Carthage, and her supply of shipbuilding materials apparently inexhaustible, she had only to destroy the prestige of the Carthaginians to make her pathway to commercial greatness an easy one. This she did, notwithstanding that, so great was her ignorance of ships, she had to take as a model for the vessels of her first fleet a Carthaginian galley that had been wrecked on her coast. Having annihilated the navy of the Carthaginians, she completed her vengeance by totally destroying Carthage itself. Thenceforth her progress was unimpeded. Even the transfer of the seat of empire from Rome to Constantinople did not materially affect her trade, but simply transferred its centre from the Tiber to the Bosporus. The position of Constantinople was wonderfully well suited to make her a centre of trade, and the policy of the earlier of the Eastern emperors was calculated to enhance her geographical advantages. Valentinian and Theodosius exempted shipowners and sailors from the payment of taxes, and Justinian incorporated these principles into his code. From the capture of Rome by Genseric, the commercial progress of Constantinople was very rapid. She had a magnificent harbor, a good position, every facility for shipbuilding, and she protected and increased her navy, so that at the time of her greatest prosperity she was the first naval power of the world.

The power and prosperity of the Roman empire began gradually to decline under the imbecile rule of the Greek emperors, and a new maritime power arose in Venice that was for centuries to monopolize the trade of the world. The centre of civilization was making another voyage, this time to the northward, and Venice and her sister republics, sprung from the ruins of the Empire, found themselves in the direct line of communication between two civilizations, an old and a new; between producers and manufacturers, as Tyre and Carthage and Rome had done before her. The rise of Venice was, however, not due to her position alone; her policy was a most far-sighted one; and it is well to note that, although this policy was, in the main, a protective one, with her, ships were free. She paid great attention to her navy, without which she must speedily have succumbed to some of the rival powers that surrounded her. She also founded a number of colonies along the coast of the Adriatic.

Venice had then the advantages of a good harbor, a position admirably fitted to give her control of the large trade that was springing up between the rapidly developing powers of the north and the older powers of the east and south. She was unable to build ships as cheaply as some of her neighbors; she therefore allowed her citizens to buy their ships wherever they could get them cheapest.

The discovery of America and of the new route to India by the Cape of Good Hope were deathblows to the prosperity of the Italian Republics, while they brought Spain and Portugal to the front rank of sea-powers; but the centre of commerce, still following the track of civilization, settled this time in the Netherlands, whose ships soon became carriers for all the world. Their rise to maritime supremacy was facilitated by a number of circumstances. They had an extended sea-coast and numerous harbors; they were a spirited and enterprising people, and early showed great aptitude for nautical affairs; they were at peace, while their neighbors were at war; they permitted the greatest freedom of intercourse, allowing the free importation of all kinds of shipbuilding materials, and they spent large sums on their navy, fully aware that on its strength depended the permanence of their shipping. They also founded colonies, notably in America and in the East Indies, that had a great influence upon the growth of their commerce. The Dutch then possessed the same advantages that were found in Tyre, Carthage, Rome and Venice at the time of their greatness. They had numerous harbors, a central

position, favorable laws, a strong navy and rich colonies. Like Venice, they were unable to build ships as cheaply as some of their northern neighbors; but, unlike Venice, they only allowed the free importation of shipbuilding materials, not of ships.

In the fourteenth century the English began to perceive that their mariners were not inferior to the Dutch in that peculiar genius for seafaring, that compound of skill and hardihood that must generally be found in the sailors of a nation that is to become great on the seas. They therefore began to make some efforts for the extension of their shipping; but, although greatly favored by nature in their many good harbors and in their insular condition, they were unable to make any headway against very adverse laws. In 1467, however, Edward VI, seeing the necessity of vigorous effort, began to amend these laws, making several treaties of reciprocity, and from this year British shipping on the high seas may be said to date. A long and pertinacious struggle then ensued between the Dutch and English for the sovereignty of the seas, and, although the former may be said to have been victorious, British commerce and shipping were brought to a higher position than they had ever occupied before. Cromwell aimed some characteristically hard blows at Dutch shipping in the famous Navigation Laws, that remained in force until repealed after a long discussion and in the face of strong opposition in 1849. These laws destroyed all Dutch participation in British trade, except the direct trade between Great Britain and the Netherlands, and from their enactment British supremacy on the high seas may be said to date.

The supremacy that Great Britain had achieved by the close of the eighteenth century may be assigned to the following causes, viz. First, to her numerous splendid harbors. Second, to her position. Third, to her policy. Fourth, to her strong navy. Fifth, to her colonies. Sixth, to her ability to build and run ships cheaply.

A few general conclusions may be drawn from this review of the six great sea-powers of the past. 1. The relative geographical position of a state is very powerful in determining whether or not it can be great on the seas. Each of these powers has at the time of its greatness been situated between two civilizations, an old and a new, between producers and manufacturers. If the state represent either extreme, that is, either manufacture or produce more than it needs for home consumption, then it may be said to fulfil this condition most perfectly. This amounts to saying that commerce is favorable

to the development of a shipping. A country neither manufacturing nor producing a surplus can only be a great carrier when it possesses this favorable geographical position, and this is equally true whether the carrying be done by land or by water. These were the circumstances under which the Netherlands and Venice rose, for although they were doubtless manufacturers, their manufactures were not greatly in excess of their own wants until their commercial marines had been firmly established.

2. A state, to be a great carrier, must be able to run ships as cheaply as its rivals. Since interest on first cost is an item in the expense of running a ship, it follows that it must be able to build ships as cheaply as any or to buy them in the cheapest market, or failing in these, must save enough in the other running expenses to make up this loss of interest on first cost. This condition has been fulfilled by all of these great powers. Tyre and Carthage built the cheapest and best ships of their time. After the destruction of Carthage, Rome for a long time had the field to herself, and it mattered very little whether she could build or run ships cheaply or not; but, when the seat of empire was removed to Constantinople, rivals began to appear, and it was found necessary to aid her shipping in many ways, among others by exempting it from taxation. The Venetians bought their ships wherever they could get them cheapest; and the Dutch, with whom it was the material and not the labor that made ships dear, allowed the free importation of shipbuilding materials. England had cheap labor and the inexhaustible forests of her colonies to draw upon for materials.

3. No nation can have a great commercial marine of any permanence unless she protects that marine by a proportionately strong navy. It does not follow from this that a strong navy will produce a merchant marine; but the reverse does follow, because if the naval force does not increase with the merchant marine, that marine, being unprotected, will surely, sooner or later, be destroyed by some stronger naval power. If a strong navy does not necessarily produce a merchant marine, it goes a great way towards it. The citizens of a nation that possesses a powerful naval force have no hesitation in going to distant and uncivilized countries to engage in trade, confident that the presence of their war-vessels will prevent outrages and insults, and that if by chance any should occur, they will be followed by summary punishment. People, thus settled in foreign countries, naturally prefer vessels carrying their own flags for their trade, and

in numerous instances a great increase in the tonnage of certain countries has been the result of such settlements—settlements that would only have been made under the protection of a strong naval force Again, the maintenance of a strong navy is a great encouragement to private shipbuilding interests if, as should be the case, private builders are given such contracts as their enterprise and ability merit. Captain Luce quotes Hamilton as saying that "the necessity of naval protection to external or maritime commerce, and the conduciveness of that species of commerce to the prosperity of a navy, are points too manifest to require a particular elucidation; they, by a kind of reaction mutually beneficial, promote each other."

The past then teaches us that any state to be a great ocean-carrier must have:

1. A favorable relative geographical position.
2. The ability to run ships cheaply.
3. A strong navy.

Other conditions, such as a great commerce, good harbors, a national aptitude for seafaring, and rich colonies, are without doubt desirable, but they cannot be called requisites. Venice and the Netherlands attained their high positions by carrying other peoples' goods, and Venice had but one harbor and that a poor one. Rome became a great sea-power in spite of a decided antipathy for the sea among her citizens, while colonies are rather a consequence than a cause of merchant shipping.

The establishment of the independence of the United States brought forth a new maritime power, whose progress we will attempt to examine in the light of these lessons of the past. They were from the first fully equipped for an immediate competition for the carrying trade of the world; commerce and shipping were nothing new to them, for under British rule a large and lucrative trade had long existed between the West Indian and American colonies, while their extensive fisheries had created a race of bold and hardy seamen, that were within the next fifty years to carry the American flag to every port of the habitable globe. Shipbuilding materials were cheap, and it then seemed inexhaustible. With a very extensive coast and numerous and fine harbors, they were producers of a large excess of raw products and wanted many of the manufactures of the old world. They *had* a commerce: the only question was who should carry it. No intermediate power existed whose position could give it any advantages over the extremes of this commerce. Should England,

the great manufacturing power at one extreme, or the United States, the producing power at the other, have this trade? Their ability to build ships cheaper than the English settled this question in favor of the Americans. The vast and fertile West was then unexplored, manufactures were undeveloped, and men of spirit and enterprise turned with eagerness from the cultivation of the rocky soil of New England to an attractive and lucrative career on the seas.

Congress took an immediate interest in American shipping, inaugurating a system of retaliation upon Great Britain for her Navigation Laws by means of discriminating duties. In 1792 the Navigation Laws, substantially as they exist to-day, were passed. They provide, among other things, that a vessel to be entitled to the rights and privileges (?) of a vessel of the United States in the foreign trade, must be registered in the United States; that to be registered in the United States, it must have been built in the United States, must be wholly owned by citizens of the United States, and must be commanded and officered by citizens of the United States. In 1817 Congress, as another retaliatory measure, passed laws similar to the British Navigation Laws, but repealed them when Great Britain, in 1849, repealed hers; reserving, however, the United States coasting trade to our own vessels. From their independence down to 1862, the absolute growth of the shipping of the United States was steady and rapid, the total tonnage being in 1789, 201,562 tons, in 1800, 972,000, in 1825, 1,423,000, in 1850, 3,535,000, and in 1860, 5,353,000. The registered tonnage was in 1789, 123,893 tons, in 1800, 559,000, and in 1860 about 2,500,000 tons.

The reasons for this growth, other than those already assigned, are not difficult to perceive. The United States not only possessed the three prime requisites, a favorable relative position, cheap ships and a strong navy, for in those days our navy was relatively more than ten times as powerful as it is to-day, but they possessed almost all the secondary advantages, such as splendid harbors, a good commerce, and sailors whose enterprise and daring were only equalled by their skill. The United States were growing in wealth and in population much more rapidly than any other country, and our shipping, in order to simply hold its own, would have had to grow in the same ratio. This was the case; for the first seventy years of our existence our shipping grew, as it should, with the country and nothing more. The total tonnage of the United States was in 1800, .18 ton per capita, and in 1860, .17 ton per capita. The registered

tonnage was in 1800, .10 ton per capita, and in 1860, .08 ton per capita. That our foreign shipping held its own so well during these sixty years, notwithstanding it was greatly harassed by laws and restrictions, was due to the following favorable circumstances, viz.:

1. American ships were much cheaper than English. This difference was due to the less cost of timber for shipbuilding in America, to improved methods of building and to the superior skill of our shipwrights, and was notwithstanding the fact that labor was higher, and that we had to import iron from England and hemp from Russia. Our ability to build cheap ships was used as a strong argument against the repeal of the British Navigation Laws. It was stated before a committee of the House of Lords in 1847, that a ship that would cost £15 per ton, if built in England, could be built in America for £12 per ton, and that the repeal of the Navigation Laws, making ships free, must destroy British shipbuilding. Their repeal certainly did great damage to British shipbuilding interests, which then consisted almost entirely of wooden shipbuilding, but when they repealed those laws, the British had made up their minds that they must give up the fight with wooden ships, that they could never overcome the advantages in that industry that our vast forests and mechanical ingenuity gave us. They concluded that it was better to attempt to retain the carrying trade by allowing their citizens to get ships in the cheapest market, although to do it they had to give the death-blow to an already expiring industry, than to attempt to postpone an inevitable death and thereby lose the carrying trade. What was the result? British wooden shipbuilding died, but the carrying trade lived and grew mightily, and British capitalists and inventors, perceiving that the demand for ships was great and steadily increasing, set their wits to work to devise means for supplying that demand, and any one who wishes to see the result may do so on the Clyde or on the Tyne, or in any harbor of the world from London to Shanghai, from Liverpool to Valparaiso.

2. American ships could be run for less money than English ships. It was stated before this same parliamentary committee that it would cost £2186 to run for one year a British ship of five hundred tons costing £8750, while an American ship of the same tonnage, and costing but £7250, could be run for the same time for £1828, a difference in favor of the American ship of £358. If we add to this the difference between the interest at five per cent. on the first cost of the two ships, we shall have a total difference of £433 in favor of

the American ship. What wonder that the English were unable to compete successfully with us when they had to pay twenty-five per cent. more for their ships and it cost six per cent. more per year to run them! In other words, if both received the same freights, carried equal cargoes, and made the same number of trips, the American ship would be making a profit of five per cent. while the English barely paid expenses. These conditions are almost exactly reversed to-day, and still people wonder that our shipping does not revive. But the American ship was put at a still greater advantage over its English rivals by receiving higher freights, carrying greater cargoes, and making more trips per year. This was due to the following circumstances:

1. American ships were superior to the English. They were faster, of lighter build, and of superior construction. They, therefore, made more trips, other things being equal, carried greater cargoes, and cost less for repairs than their competitors. So marked was this superiority that the American clipper ship, of this period, was the model all over the world for everything that was perfect in ship-construction.

2. The American captains were greatly superior to other captains. They were frequently men of education and refinement, sometimes graduates of colleges, who were attracted to the sea by love of adventure or of money; for American ships in those days were the first to explore strange seas, and the successful captains received large profits. Therefore, although they were paid much better than other captains, they, in return, by their superior intelligence, made better passages, with less damage to ship, cargo, and equipment, getting thereby almost a monopoly of certain valuable goods and of the passenger traffic.

3. The American seamen were much superior to others; they were better educated and therefore more intelligent; they had a fertility in resource and an ingenuity in contriving labor-saving appliances that were altogether unknown in the seamen of other countries, and the best of them always looked forward to advancement and frequently owned shares in ship or cargo. So marked was this superiority that it was common to consider twenty American seamen enough to man a ship that would require thirty foreigners. 1,618,000 tons of American shipping that entered New York in 1861 were manned by 44,774 seamen, or 2.8 men to one hundred tons, while 865,000 tons foreign were manned by 33,490 men, or 3.9 men to

one hundred tons, a difference probably somewhat due to the greater size of American ships, but more to the superior intelligence of officers and men.

The Decline.

In treating of that part of the subject relative to the decline of our shipping, it will be necessary to distinguish between that engaged in foreign and that in domestic trade. One has declined both absolutely and relatively, the other only relatively, and its decline has been due to natural and not artificial causes ; one occupies a field open to all nations, the other one closed to all but United States ships ; in one the ships of some nations sail under much more favorable conditions than those of other nations, in the other all competitors are on an equal footing, the citizen of New York or of Pennsylvania having perfect liberty to go to Maine for his ships, regardless of the fact that shipbuilding in New York and Pennsylvania must suffer thereby, and that it would be a good thing for both these States to build ships. Causes that may effect a decline in one might encourage the other, and laws calculated to revive one might destroy the other ; in fact, the conditions of the two trades are so widely different that any attempt to deal with both in the same article would be out of the question. Shipping engaged in foreign trade is, doubtless, that referred to in the title, and hereafter the word shipping will be used as referring exclusively to that.

It was shown above that the shipping of the United States was almost exactly the same in tons per capita in 1860 that it was in 1800. If the *demand* for a foreign shipping was relatively no greater in 1860 than in 1800, it would be fair to conclude that no decline took place prior to 1860. That this demand *was* relatively greater is unquestionable, for our foreign commerce increased much more rapidly than our population.

The following table shows, for each year given, the tons of registered shipping, the population, the commerce (exports plus imports), the tons per million inhabitants, and the tons per million dollars worth of commerce.

Year.	*Reg. Ship.*	*Population.*	*Commerce.*	*Tons to million people.*	*Tons to million of commerce.*
1820	619,000	9,633,000	108,126,000	64,258	5,731
1850	1,586,000	23,191,000	300,134,000	68,388	5,286
1860	2,546,000	31,443,000	708,422,000	80,972	3,596
1865	1,602,000	33,000,000*	418,000,000	48,545	3,832
1880	1,314,000	50,153,000	1,583,003,000	26,280	830

*Approximately.

In examining the causes of the decline of our shipping, it will simplify matters much to divide the sixty years between 1820 and 1880 into three periods, that before the war, that during the war, and that since the war. It will further simplify matters to separate the first period, extending from 1820 to 1860, into two sub-periods; and the first of these sub-periods, from 1820 to 1850, we will proceed to examine. By referring to the above table, it may be seen that during these thirty years our registered shipping increased from 619,000 to 1,586,000 tons, the population of the country from nearly ten to twenty-three millions, and the commerce from 108 to 300 millions. This gives an increase from 64,258 to 68,388 tons to the million inhabitants, and a decrease from 5,731 to 5,286 tons for every million dollars worth of commerce. This increase of 4,130 tons to every million people might, under certain circumstances, have indicated a flourishing shipping, but the next column shows that our shipping was not keeping pace with the demand for it, and hence could not have been flourishing. There was a loss in this respect of 445 tons to the million of commerce; small, to be sure, but still a loss, and a loss that, had this subject been carefully studied, ought to have served as a warning that there was something radically wrong about the conditions under which our shipping was carried on. England, in 1838, introduced steamers into the transatlantic trade; and this, followed, as it was the next year, by the Cunard line, and, year by year, by other measures equally sagacious and prophetic, was the first step in her wonderful ascent to the monopoly of the carrying trade and the first cause of our decline. This introduction of steamers threw the passenger traffic and most valuable and perishable freights into British hands, and was a heavy blow to the famous American clippers that had had, until now, these trades in their own hands. The Americans did not succumb easily, but made a desperate, although vain and mistaken struggle, by fitting their clippers with auxiliary engines. Such efforts were only useful in showing how little the change that was to be wrought in nautical affairs by the steam-engine was realized at that time on this side of the Atlantic. From 1842 to 1849 the English were establishing their system of free trade, which, whatever may be thought of it now, gave an immediate and powerful impulse to their commerce, and culminated by giving them free ships in 1849.

During the next ten years, from 1850 to 1860, our tonnage increased to 2,546,000 tons, our population to 31 millions, and our

commerce to 708 millions. This gives an increase from 68,388 to 80,972 tons per million people, but a decrease in tons to the million of commerce from 5,286 to 3,596. Here was evidently a decline, and a great one too. Growing as it was (it had increased one million tons in these ten years), our shipping was not keeping pace with the demand for it, our commerce. And why? Simply because it was unprofitable. During the latter part of this decade ships were noticed, for almost the first time in our history, lying idle at the wharves. Shipbuilding almost entirely ceased. The English had introduced the iron steamer, a weapon against which it was futile to contend with arms of wood and canvas. The old wooden sailing ships had met this new enemy bravely, but in vain; they have never since occupied anything but a very subordinate place in the world's trade, and day by day their sphere becomes more and more restricted and their profits less. Yes, the iron steamer, that masterpiece of science and mechanical skill, whose progress has astonished its most sanguine advocates, was undoubtedly the weapon with which England won the fight. She had vast coal fields, her iron mines were rich and productive of ores well fitted for shipbuilding, and her inventors and capitalists far-sighted enough to see that the slow and expensive sailing ship would be no match for the swift and cheap iron steamer. During these years England began to do our carrying for us. Some idea of the revolution that was taking place on the sea, in consequence of this introduction of iron steamers, may be formed from an examination of the shares Americans and foreigners had in the trade of the port of New York during the last years of this decade and the first of the next. In 1857 the per cent. of foreign entries at New York was 25, in 1858 26, in 1859 31, in 1860 31, and in 1861 35. In 1820 but ten per cent. of the entries at New York from abroad were foreign, and in 1861 thirty-five. There is every reason for believing that, had the rebellion not occurred, the iron steamer would have annihilated our shipping just as surely, if not as rapidly, as did war and high taxes.

The decline of our shipping was then due,

1. To the introduction of steamers by the English.
2. To their adoption of free trade.
3. To their introduction of iron shipbuilding.

These three reasons may be stated in one, and the decline of our shipping assigned to the appearance of the English iron steamer and the non-appearance of the American iron steamer.

There can be no doubt that the first serious blow to our shipping was dealt with British steamers. Had our shipbuilders and shipowners shown that they realized the turn affairs were taking, and exhibited their customary energy in meeting the emergency, there would have been no immediate necessity for their withdrawal from the contest; for so long as steamers were of wood, they could have saved enough in the cost of building to pay for the extra cost of the machinery in America. Instead, however, of putting steamers at once in competition with the English, they lost much valuable time in trifling with auxiliary-engined clippers, and in doing nothing. The English did not confine their progress to the steamer, but very soon began making it of iron, and by the time we had awakened to the fact that an iron steamer was better in every way than a wooden one, the war came, and for a number of years all hopes of building iron steamers as cheaply as they could be built in England were vain. Since the day the English have built iron steamers cheaper than we could wooden ones, they have been complete masters of the situation; all attempts to compete with them, either with wooden or iron steamers of American build, have been as vain as were their attempts to compete with us forty years ago, and for the same reasons.

The effect of free trade upon British shipping, coming as it did along with free ships, was to give it an immediate impetus. Mr. Gladstone says that every dose of free trade, from the repeal of the Corn Laws in 1842 to the passage of the Customs Act of 1860, was followed by an immediate increase of British commerce, which has grown from £47,000,000 of exports in 1842 to £190,000,000 in 1878. And it must be remembered that this increase means much more than would a similar or greater increase in the United States. Great Britain has no such rapidly increasing population, and her natural resources are capable of no such extension and development as ours are. British shipping was placed by the repeal of the Navigation Laws in such a condition that it was enabled to profit to the fullest extent from this enormous increase of commerce. Its influence sent British ships with British cargoes to every port of the world, and ship captains and owners were not slow in discovering that they could carry British imports as well as exports; more, that they could carry profitably between two foreign ports.

We made but one serious attempt to compete with the British for the transatlantic trade, and that was by granting a subsidy of $19,500

per trip to an American line that was required to make twenty trips per year. The cost of these steamers proved to be so unexpectedly great, compared with that of the English iron steamers with which they had to compete, that it was found necessary to increase the subsidy to $33,000 per trip, and to require but four instead of five steamers as originally intended, the same number of trips being guaranteed. The American line soon became popular, and succeeded in getting a large share of the passenger traffic; but notwithstanding this and its subsidy of $660,000 per year, it was unprofitable, and the withdrawal of its subsidy in 1858 was followed by its immediate collapse.

Had we been able to build iron steamers as cheaply as the English, or to buy them in the cheapest market, there can be no doubt that we would have retained our full share of the carrying trade, for there is no reason for believing that American skill and enterprise would have been any less conspicuous in the management of steamers than they had been in that of sailing vessels. But handicapped as we were with costly steamers and antique and cumbersome laws, what could skill and enterprise avail?

The decline of our shipping was then due to causes that were in full force years before the rebellion.

We come now to the second period of decline—that of the war. The outbreak of the rebellion found us with a shipping that, although suffering greatly from causes outlined above, was yet sufficiently large and unprotected to attract the attention of the enemy. It was our weakest point, for our naval force was totally inadequate either to the protection of our shipping or to the establishment of an efficient blockade, let alone both. The efficiency of the blockade was of the first importance, and to it our shipping was sacrificed. Between 1860 and 1865 our shipping fell from 2,546,000 to 1,602,000 tons. A few swift hostile cruisers were able in four years to reduce it 944,000 tons. English steamers were again at work, completing in perfidy a destruction they had begun in honorable rivalry. Of this absolute loss of nearly one million tons, more than one half, or 715 ships of 480,882 tons, was transferred to the British flag. Had England's navigation laws been similar to ours she would have lost this accession of half a million to her merchant fleet. To secure her in the possession of these ships, Congress, early in 1866, expressly forbade their coming back under the American flag. It is difficult, at this day, to understand what could have influenced the passage of an act whose only effect was to deprive us of all hope of regaining a half million or

more tons of shipping. Was it only because its owners sought under foreign flags a protection the United States was unable to afford them? The remainder of the shipping lost during the rebellion was sold abroad, transferred to flags other than English, captured and destroyed by the enemy and by our forces, and purchased by the government.

The direct effect of the rebellion was then to deprive us of a million tons of shipping; its indirect effect it is impossible to calculate. The seamen of our merchant marine were taken to man our war vessels. These might have been to some extent replaced by foreigners; but ships must have masters and officers, and in American ships these must be Americans; and masters and officers, as well as seamen, were taken by the government. Had our ships been fully officered and manned without calling on the merchant service, there would have been no escape from transfer to other flags or tying up to the wharves, for a diminished commerce, heavy taxation, and the cruisers of the enemy destroyed all chances of profits. Ships of owners unable or too patriotic to change their colors were compelled to lie idle in port, not only earning nothing, but subjecting their owners to heavy loss from taxation. A combination of these circumstances,—heavy taxation, diminished commerce, and the cruisers of the enemy—was enough to ruin nearly all our shipowners. Their ships may be seen to-day in every seaport lying just where the war left them, silent proofs, with their gaping seams and rusty iron-work, of the Republic's neglect of servants to which it has owed so much of its prosperity and glory.

The decline during this period was due to a combination of two things: 1. English iron steamers; 2. The insufficiency of our naval force. Had we possessed in 1861 a navy in any way adequate to our wants and greatness, there would in the first place have been no such drain upon our merchant marine for officers and men, and in the second place the hostile cruisers would have been captured or shut up in port long before they had time to do one-tenth of the damage they did. Indeed there seems every reason to believe that had we had any navy in 1861, the war would have been over in two years at the most. Had the bombardment of Fort Sumter been followed by the instant blockade of all Southern ports, the South would have lost the vast quantity of arms and munitions that she received from abroad during the interval that elapsed between that and the establishment of a blockade, and the struggle must have been greatly shortened if not entirely prevented.

We come now to the third period of decay, a period during which our shipping has declined much more rapidly and alarmingly than ever before. We had, in 1865, 1,602,000 tons of shipping, 48,545 tons to the million of people, and 3,832 tons to the million of commerce. To-day we have 1,314,000 tons, 26,280 tons to the million people, and 830 tons to the million of commerce,—26 tons where we had 48 in 1865, and 8 tons where we had 38! In 1860 71 per cent. of our foreign commerce was carried under the American flag; in 1864, 46 per cent.; in 1868, 44 per cent.; in 1872, 29 per cent.; in 1876, 28 per cent.; in 1880, 17.6 per cent., and in 1881 but 17.3 per cent.! If anything like this decadence continues, it is a very simple matter to predict the year that will see the total disappearance of the American flag from the high seas. This is a subject deserving of the gravest consideration. That a people, once so bold and enterprising in this field, should stand idly by and see its ancient glories departing, money poured into the pockets of foreigners for doing something which they once did better than anybody else in the world, betokens either an alarming deterioration of the American people or gross injustice in their laws. That the American people is deteriorating is manifestly absurd. The sole difficulty is in our laws; *they do not permit American ships to be run as cheaply as foreign ones are run.* Americans must pay more for their ships than their foreign rivals; they must pay more for wages to officers and men, more in taxes, higher consular fees, tonnage duties where their rivals pay none; they are charged with the support of destitute seamen; they have to pay higher rates of pilotage, and often excessive port dues.

For many years after the war capital was scarce and fields for its investment numerous and promising. Men would not then have been satisfied with the profits that steamship lines, even the best, make now. To-day all this is changed; capital is abundant, and men are everywhere in the United States seeking new fields for the investment of their surplus. There is every indication that, if the conditions are so modified that American ships can be run with a reasonable chance of moderate profits, there will be capital in the greatest abundance.

The Suez Canal has been another powerful cause of the decline of American shipping,—of the decline of all sail shipping. The old route to India and China is superseded by one that only steamers can profitably follow. The old tea-clippers that annually raced to England and America with the first crops are replaced by steamers

that run from Amoy to New York in less than two months. I doubt very much that an American merchant ship has ever passed through the Suez Canal. Much is said of the great advantages to the United States that will result from a canal across the American isthmus. Unless something shall have been done, by the time of its completion, to give us a steam shipping, it not only will do us no good, but will probably result in actual injury.

To properly appreciate the decline of our shipping we must compare our condition to-day with that of the most prosperous time. We had in 1850 1,586,000 tons of registered shipping, we now have 1,314,000; then we had 68,388 tons per million inhabitants, now we have 26,280. We now have 830 tons to carry every million dollars worth of commerce; then we had 5282, or 53 tons where we now have 8! These figures might prove nothing had our shipping been transformed from sailing vessels to steamers, for a thousand tons of steam shipping will do as much carrying as two or three thousand tons of sailing vessels; but such is not the case.

Our merchant shipping has then declined just as we have failed to fulfil the conditions found necessary from the experience of the past. The decline began the day our rivals were able, with iron steamers, to carry freights cheaper than we could with wooden sailing ships; was aggravated by our failure to possess a navy equal to its protection and by our loss of commerce during the rebellion, and has continued in spite of our very favorable position and great and increasing commerce, because we have neither cheap ships nor navy.

The Remedy.

The United States possesses to-day everything that nature can give to make her a great carrying power. She has an enormous commerce, numerous good harbors in the direct line of this commerce, and her people have not lost that genius for the sea that made our flag known and respected in every port of the world thirty years ago. She has the first prime requisite—never more of it—for her relative geographical position has never been more favorable than it is to-day. The other two prime requisites, that she has to depend on man for, she lacks. She has neither cheap ships nor a navy. Give her cheap ships, not only ships that can be bought cheap, but ships that can be run cheaply and laid up cheaply, and as this is done give her a navy, and if she does not then acquire and maintain a merchant

fleet it will be the fault of her people, not of the government. I shall attempt to show how this may be done.

The late Secretary of State said in a recent letter to a member of Congress: "But American ships do not sail under the same conditions with ships of European countries. We place burdens and costs and taxes upon our vessels, from which vessels of other countries are exempt. In short, we load them down with exactions and oppressions, and then rub our eyes and wonder that American ships do not hold their own in the international contest for the trade of the world." The Secretary of State was in favor of doing away with all of these exactions and oppressions but that of first cost, and of removing that disadvantage by giving subsidies. Here is the first "exaction." Americans are *compelled* to pay more for their ships than their foreign rivals. To attempt to compensate them for this loss by subsidies is regarded by most disinterested thinkers as erroneous in theory and pernicious in practice. If subsidies be given to American ships to make up for losses which they would otherwise suffer in a competition with the ships of any nation, then a less subsidy from that nation to *its* ships will again place them at an advantage. Will England stand by and see her carrying trade ruined by subsidized American ships, their profits coming from the Treasury and not from their business, when she is as well able to give subsidies as the United States, and by giving them she can preserve it? It is hardly to be expected. Both nations would probably start on a race, whose only goal would be disaster, and whose prize would fall to some nation that had sense enough to stand by. The only apparent limit to subsidies under such a system would be the purses of the subsidizing powers.

It is constantly stated by the advocates of subsidies that we can never hope to compete with England on the high seas until we consent to subsidize as she has done and does. Let us see what she has done in this direction. Since 1837 she has paid yearly between four and five millions of dollars to her shipping for postal service. This payment dates from the introduction of ocean-going steamers, and its main purpose, then, was to encourage that introduction. In this way it was at first, doubtless, a subsidy, as the money thus paid must have been largely in excess of the value of the service rendered. But there is a vast difference between subsidies thus paid and subsidies as understood by their American advocates to-day. This money was paid to encourage, not shipping so much as postal com-

munication. The steamship promised certain and comparatively quick communication between England and her numerous and distant colonies. The mail compensation thus paid was never called a subsidy and was never understood as such, nor is it so understood to-day by Englishmen. It is money paid for service rendered. England had in 1880 2,730,000 tons of steam shipping, and paid for postal service about $5,000,000, or $1.83 to the ton. Would our would-be subsidy-grabbers be satisfied with a subsidy of $1.83 to the ton? I venture to say that nothing less than ten times that amount would satisfy them or enable them to compete with English steamers, unless other conditions are greatly modified. Mr. David A. Wells calculates that $35 per ton would have to be given to enable American ships to compete with English. In this connection, a well-known American advocate of subsidies speaks of the "terrible wrong" of compelling American ships to carry the mails for two cents per half ounce. Under this law, he says, American ships received $31,405 for carrying the mails last year. At two cents per letter this would make the number of letters thus carried 1,570,000. The total number of foreign letters mailed last year in the United States was 34,580,000, for which the government paid $198,667. 33,009,750 letters were carried by foreign ships for $167,262, or one-half cent per letter. Foreign ships carry our letters for just one-fourth what we pay our own. Where is the "terrible wrong" of this law? Two cents per half ounce is considerably more than one thousand dollars per ton. Happy the shipowner who could fill his ship with such a cargo. Had our mail all been carried by American ships last year, it would have cost the government over one million of dollars instead of $198,667, as it did. American ships would then have received a "subsidy" of one million dollars. I venture to say that England, with her four or five millions per year for carrying mails to her numerous colonies, to foreigners, to her soldiers and merchants all over the world, pays no more per letter to her ships than we do to ours. Let us dismiss this subject. England *does not* subsidize her steamship lines to-day, whatever she may have done when the steamship was a venture and its proper development depended on such encouragement.

A ship that needs a subsidy is one that without it would be run at a loss, if run at all. Giving it a subsidy transfers that loss from the ship's owners to the taxpayers. How are subsidies to be given? If given to any, they must be given to all ships that fulfil certain

conditions. Evidently all the ships we would have under such a system would be subsidized ones. With a respectable fleet, the amount that would have to be paid in subsidies would be very great. For a fleet of one million tons only, the amount would be, according to the above-mentioned estimate, thirty-five millions of dollars, and to equal England's fleet, about seventy millions of dollars under our present laws. Increased taxation must result. Increased taxation means increased cost of labor, more expensive ships and less business for them, that is, less commerce. All this means lower freights for the steamers, hence increased loss, and *must* mean, if they are to be maintained, increased subsidies. The system, as Prof. Sumner says, continually "works down." The more subsidy you give the more you have to give. "But we don't mean to go into such wholesale subsidizing as this," perhaps some will say. Very well, then, you must be satisfied with a secondary fleet, for subsidized vessels will surely drive unsubsidized ones off the seas. Another thing must be remembered in any attempt to force an American merchant shipping into existence, and that is, that the supply of ships to-day is fully equal to the demand for them. If subsidized American ships are put afloat in excess of the demand, as they probably would be, freights must fall, and then comes a new and unlooked-for loss for American shipping: it must have a little more subsidy.

The opponents of free ships point to the great development of many of the protected industries of the country as a strong reason for a continuance of the present system with regard to ships. There can be no doubt that under protection our manufactures have prospered as they would never have done under free trade. There are, however, two very important points of difference between the manufacture of watches or of locomotives and that of ships. In the first place, an American may buy a watch or a locomotive wherever he pleases, which is usually where he can get it cheapest, but he *must* buy an American-built ship or none, if he wishes it to sail under the American flag. He may not sail a foreign-built ship under the American flag under any circumstances, not if he pays ten times its value in import duties. Counterfeit money, obscene objects, and ships are the three things that the American citizen is forbidden to import. Protection to American watchmaking and locomotive building simply renders it expedient for the American to buy watches and locomotives at home; protection to American shipbuilding commands him to buy American-built ships or do without, which latter

alternative he has been for twenty years persistently adopting. In the second place, there is a constant demand in America for watches and locomotives, while there is no such thing as a demand for ships. A man buys a locomotive to gain money with it, and it matters little to him what he pays for it so long as his competitors must pay the same. A man buys a ship for the same purpose. An American cannot buy a ship for what his competitors pay for theirs, for foreigners are influenced by no sentiment in this matter, but go invariably to the cheapest market. In one industry there is a constant demand that protection enables Americans to supply, a constant stimulus to exertion and progress. In the other there is no demand, for protection has killed it. Of course all this applies to shipbuilding for foreign trade and to foreign shipping. In the coasting trade *all* competitors are restricted to American-built ships, and they do not care what they cost. Open our coasting trade to foreign ships and see what a howl of discontent at the injustice of restricting our people to American-built ships would arise, and how quickly our domestic shipping would disappear as has our foreign.

It will not do to confound shipbuilding with other industries. It resembles no other. A prosperous shipbuilding industry must surely result from a prosperous shipping, and not, as some would have us believe, a shipping from protected and languishing shipbuilding.

There seems to be a curious diversity of opinion among the opponents of free ships. Many of them favor making American ships equal to foreign ones in every respect but that of first cost, and then compensating them for this difference by means of subsidies. A prominent shipbuilder asks for the removal or diminution of local or State taxation, but says that, because Americans have to pay more for their ships is no reason why they cannot compete with foreigners. It is significant in this connection that this gentleman's line of South American steamers was withdrawn almost immediately after the New York legislature had exempted ships from taxation.

Greater first cost *must* introduce an element of loss. It is only necessary to suppose an American steamer costing one million dollars, to compete with an English one costing one hundred thousand, to reduce the argument that this is not so to the absurd. The loss may be small, but, small or large, it is one of the "exactions" that the Secretary of State says are so prejudicial to American shipping. If their statements that this is not so are sincere, why do shipbuilders

so persistently oppose free ships and shipowners favor them? The time has come when Americans must decide which of these two sides to favor. It is impossible to please both.

Let us see what this difference of first cost actually means. The shipbuilder already quoted says that his ships only cost ten or fifteen per cent. more than equal English ones, but others equally well-informed and more disinterested say that they cost from thirty to forty per cent. more. This gentleman gives the following table to show the wrong done to American shipping by excessive taxation:

Lines.	Capital invested.	Net Earnings.	Taxation.
American,	$2,000,000	$160,000	$50,000
English,	2,000,000	160,000	1,600
Discrimination in tax against American line, . .			$48,400

There are a number of inaccuracies in this table. In the first place he supposes the two lines to have equal amounts invested in five steamers, and then puts the net earnings of each at $160,000, forgetting that, with equal amounts invested, the English steamers will be superior and hence earn more. He then puts the tax on the American line at two and one-half per cent. on the whole capital invested, whereas, in New York it would only be taxed on about sixty per cent. of its value. He says the English lines pay but one per cent. tax on the net profits, for which a British shipping journal corrects him, saying that they pay the usual tax on profits, whatever that may be,—last year it was sixpence in the pound, or two and one-half per cent. instead of one per cent.

If the net earnings of the two lines are to be equal the ships must be equal, and the American line will cost at the lowest estimate (this gentleman's) fifteen per cent. more. The table should be as follows:

Lines.	Capital invested.	Net Earnings.	Taxation.
American,	$2,300,000	$160,000	$34,500
English,	2,000,000	160,000	4,000
Discrimination in tax against American line, . .			$30,500

Now let us suppose two American lines to compete, one with $2,000,000 invested in five steamers, the other with five equal steamers for which they have to pay fifteen per cent. more. Greater first cost means greater interest, greater cost of repairs and insurance and

greater taxes. These two lines will compare as follows in these three items of expense:

	Capital invested.	Interest.	Repairs and Insurance.	Taxes.	Total.
1st.	$2,000,000	$120,000	$120,000	$30,000	$270,000
2d.	2,300,000	138,000	138,000	34,500	310,500

Discrimination against the more expensive line, . . $ 40,500

Greater by ten thousand dollars than the discrimination by taxation against American ships, about which this gentleman is so indignant, and greater by six thousand dollars than the *whole* tax on the American line. This table is based on an interest charge of six per cent., repairs and insurance at six per cent., and taxation at two and one-half per cent. And yet this gentleman, who declaims against theorists and proclaims himself a man of business, says that greater first cost amounts to nothing, and that two and a half per cent. tax is a gross injustice. Two and a half per cent. tax undoubtedly *is* a gross injustice, but compelling Americans to pay even fifteen per cent. more for their ships is a greater.

The subject of taxation on shipping has been already dealt with in a manner most favorable to it by some States, and there is good reason for believing that no complaints will in future spring from this source.

What shall be done to remedy this evil of greater first cost? But two remedies have ever been suggested,—subsidies and free ships. Some reasons have been given why it is not believed that subsidies will be either practicable or efficacious. The other remedy is a simple one,—easy of application, and sure to result favorably if applied in connection with others suggested further on. Modify Section 4132 of the Revised Statutes so that Americans may buy ships where they please, and so that it shall read, "Vessels belonging wholly to citizens of the United States, *or to companies incorporated or which may be hereafter incorporated, according to the laws of the United States*, and vessels which may be captured in war by citizens of the United States and lawfully condemned as prize, or which may be adjudged to be forfeited for a breach of the laws of the United States, being wholly owned by citizens, and no others, may be registered as directed in this title," the only change being the omission of the words "built within the United States," and the insertion of the words italicized. The omission will permit Americans to

buy ships for foreign trade wherever they can get them cheapest. If Section 4347 be so modified as to prohibit foreign-built vessels as well as vessels owned wholly or in part by foreigners from engaging in the coasting trade, this need in nowise interfere with our domestic shipping. It may be argued against this that it is only temporizing; that if we throw open our foreign shipping to foreign-built ships, we must also throw open our domestic shipping; that American lines would suffer in not being allowed to take in United States ports on foreign voyages. This is undoubtedly an objection, but not a very important one, as the ports that might be thus included are not numerous, and routes between the United States and foreign countries that would not include such ports are.

The insertion of the words italicized would permit foreigners to own shares in our steamship companies. We were once very willing to have them subscribe to our government bonds; we invite foreign capital to build our railroads and canals. Why not allow them to aid in developing our shipping?

These modifications of Sections 4132 and 4347 will necessitate the repeal of Section 4133, which forbids the registration of any vessel which belongs in whole or in part to any citizen of the United States who usually resides in a foreign country; and of Section 4134, which forbids the registration of any vessel owned in whole or in part by any person naturalized in the United States and residing more than one year in the country from which he originated, or more than two years in any foreign country. With these relics of 1792 and 1804 must go a product of a more enlightened age, but one that exceeds in intolerance and stupidity anything that has been done towards the extinction of our shipping since the establishment of our independence, and that is Section 4135, forbidding the rights and privileges (what are *they?*) of vessels of the United States to vessels that sought protection under foreign flags during the existence of the rebellion. The only effect of this law, conceived in intolerance and brought forth in spite, was to deprive us of nearly half a million tons of shipping. It was said that such desertion of the government in its hour of need rendered the owners of this shipping unworthy of the protection of the United States; that it would never do to permit such deliberate shirking of the obligation that every citizen is under to aid in sustaining his government. Is not the obligation mutual? The obligation of the government to protect this shipping was just as great as that of its owners to sustain the government. What had

these shipowners been paying taxes for, if not for protection to their property? Had the government fulfilled its part of the compact there would have been no necessity for these transfers. It was not with these men as with others no more loyal, simply a question as to whether they should pay one or five per cent. in taxes. It was whether or not they should suffer absolute financial ruin.

Section 4136, enacting that any vessel built in a foreign country and wrecked in the United States must have repairs put upon her by a citizen of the United States equal to three-fourths the cost of the vessel when so repaired, to be entitled to an American register, should also be repealed.

Section 4137 might be advantageously modified so that a vessel belonging to an incorporated company might be registered in the name of the company, instead of that of the president or secretary as now required. This would repeal the next section, 4138, requiring a new register upon the death, removal or resignation of the person registering.

These repeals and modifications would necessitate corresponding modifications in Sections 4142, 4146, 4155, and the repeal of Section 4165, which forbids that any vessel seized or captured and condemned under the authority of any foreign power, or which *by sale* becomes the property of a foreigner, shall be entitled to a new register, *notwithstanding such vessel should afterwards become American property*. Comment would be superfluous. Words are entirely inadequate to express the utter absurdity of this law.

One cannot read the laws for the regulation of commerce and navigation without getting the idea that they must have been enacted to suppress great evils,—evils that could not be entirely abolished, and that must therefore be regulated as much as possible out of existence. The shipowner was apparently regarded as the most depraved of men, who could only be permitted to exist on condition of taking frequent oaths as to his intentions, and who was only allowed to pursue his nefarious business while paying frequent heavy sums to the government for the privilege, while the unhappy ship-captain was a man whose vicious tendencies could only be restrained by the most vigilant supervision. That such laws should exist to-day on the statute books of a nation that boasts of its advanced civilization, seems incredible. Surely we have learnt something about commerce and shipping since 1792. Nowhere has there been a more complete revolution. Is it not self-evident that laws that

suited a small seafaring people with little commerce and cheap shipbuilding materials a hundred years ago, in an age of sailing vessels, are not the laws calculated to revive the shipping of a great nation, half agricultural and half manufacturing, with an enormous commerce and dear shipbuilding materials, in this age of steamers? Other nations have long ago discovered the change of affairs, and their laws are being constantly modified to keep up with the march of progress. Is it not even possible that their framers foresaw the probability of circumstances arising that would necessitate changes in them, and that they did not intend them to be handed down to eternity on our statute-books? It is not only possible, but a fact, for our history teems with proofs that our early statesmen only adopted a policy of protection and restriction after every effort had been made toward "free ships and sailors' rights,"—efforts that were vigorously opposed at every point and by every possible means by England. Prof. W. G. Sumner said, in an able article in the North American Review for June, 1881: "It is necessary, however, to go to Turkey or Russia to find instances of legislative and administrative abuses to equal the existing laws and regulations of the United States about ships, the carrying trade, and foreign commerce. . . . . We should stop bragging about a free country and about the enlightened power of the people in a democratic republic to correct abuses, while laws remain which treat the buying, importing, owning and sailing of ships as pernicious, or, at least, doubtful and suspicious actions. I have no conception of a free man or a free country which can be satisfied if a citizen of that country may not own a ship if he wants one, getting it in any legitimate manner in which he might acquire other property, or may not sail one if he finds that a profitable industry suited to his taste and ability."

The only argument against free ships is that they would destroy American shipbuilding. Let us see if this is so. It will be observed that it is not proposed to permit ships for domestic trade to be purchased abroad. That would remain as firmly closed to foreign-built ships as it is to-day. Evidently then the building of ships for domestic trade would not be affected. In 1880, of our 4,068,035 tons of shipping, there were engaged in foreign trade 1,314,402 tons, and in domestic trade and the fisheries 2,753,633 tons. Of this 1,314,402 tons engaged in foreign trade only about one hundred thousand tons were of iron. Our shipbuilding interests have been brought to their present position by building one ton of iron shipping for foreign

trade to every forty tons of other shipping. Does the destruction of a business that consists of building one-fortieth of our shipping mean the destruction of American shipbuilding? Must a trade that is fed with one steamer this year, two the next, and then for a few years none, be nourished at the expense of our material interests and future prosperity?

"But the building of iron ships for foreign trade to-day would not only be destroyed, but all hope of our ever being able to build them would be likewise destroyed by free ships," you say. On the contrary, there are the strongest reasons for believing that free ships not only would not destroy this industry, but would give it an impulse such as protection never has. For thirty or forty years it has been so pampered and protected that it can have no conception of existence under natural conditions. All incentive to exertion and all stimulus to invention have been from the first withheld. Take away this shelter of law and let us see if it will wither under the sun of competition, or will put forth new branches and prove itself vigorous enough to justify the tender nurture of the past. What if it wither? A few men who have grown rich on the nation's shame will lose, but their loss will be the people's infinite gain.

It is my very firm conviction that free ships not only would not destroy our shipbuilding, or any part of it, but would, on the contrary, encourage it. Allowing Americans to buy ships for foreign commerce where they please, and so amending our laws that they may run them as cheaply as any one, would create something that cannot be said to exist to-day—a demand in America for iron ships for foreign trade. Iron ships would be bought somewhere and run under the American flag; they would frequently, of necessity, be repaired in the United States. The shipbuilder seeing this demand a fact and likely to be a growing one, would, if possessed of the energy and ingenuity so characteristic of his predecessors, begin to devise means to save the 15 per cent. that would be sending Americans abroad for ships. This, it seems, would not be difficult if gone about under a strong incentive. It would be especially easy if, as is stated, 95 per cent. of the cost of a ship be labor. Steel will probably be the material of the ship of the future. Let an interest in shipping and shipbuilding be once aroused in the United States and there is no reason why we should not enter the field of steel shipbuilding as fully equipped as England. We are not behind her in knowledge of the manufacture and manipulation of steel: why

should we not as successfully compete with her in the manufacture of steel ships as of steel cutlery or agricultural implements? Under this system there will be the same home demand that has built up these other industries, and the same foreign competition that has stimulated progress and reduced prices.

The truth of the whole matter is that our shipbuilding is an artificial industry. Its growth has been anything but natural. No one but those interested wants it to remain longer in this abnormal condition. The present system has had a fair trial and has given us neither shipping nor shipbuilding. Let us try the other, which at least will give us the former, and at the worst can only destroy a monopoly that has lasted long enough.

The next exaction to which American shipping is subject, that it is proposed to consider, is that of tonnage duties. Section 4219 of the Revised Statutes establishes the following tonnage duties for vessels entered at custom-houses of the United States: On vessels of the United States, thirty cents a ton; on vessels built within the United States, but belonging wholly or in part to foreigners, sixty cents per ton; on foreign vessels from ports to and with which vessels of the United States are not ordinarily permitted to enter and trade, two dollars and thirty cents a ton; on other vessels, thirty cents per ton: *Provided*, that the President of the United States shall be satisfied that the discriminating duties of any foreign nation to which such vessels belong, so far as they operate to the disadvantage of the United States, have been abolished; otherwise, eighty cents per ton: *And provided*, that nothing in this section shall impair any rights and privileges which have been or may be acquired by any foreign nation, under the laws and treaties of the United States, relative to the duty of tonnage on vessels. A treaty between the United States and Great Britain, ratified December 22d, 1815, provides that "no higher duties or charges shall be imposed in any of the ports of the United States on British vessels than those payable in the same ports by vessels of the United States," and similar clauses are found in our treaties with other powers. Therefore, since the vessels of countries not discriminating against vessels of the United States must, upon entering ports of the United States, pay only the same duties that are paid by vessels of the United States, this law cannot be said to operate to the disadvantage of ships of the United States competing with foreign ships between a port of the United States and any foreign port. It is only when ships from our ports attempt to compete

with ships from foreign ports for other foreign ports that the injustice of this law is felt. For instance, suppose an American line from New York and an English line from London, each carrying cotton to Shanghai. If each line owns twenty-five thousand tons and all conditions but that of tonnage duties are equal, the American line will start each year with a discriminating tax of seven thousand five hundred dollars upon it. The English line will pay nothing in tonnage duties. If we each manufacture cottons at the same cost, it is evident that ours will be dearer than the English by the time they reach Shanghai. It may be said that this is a small item. So it is ; but by saving just such items as this England is able to command foreign markets. These duties are simply a direct tax of thirty cents per ton on *all* registered American ships that are in service, while they only affect that foreign shipping that runs to ports of the United States.

The most logical remedy for this exaction would be to abolish these duties for American vessels and to require foreign vessels to pay, not the same duties as our own, which would be nothing, but the same duties that our ships have to pay in their ports. The rule adopted, that of only requiring vessels of countries not discriminating against our vessels to pay the same duties that ours pay, seems very illogical, for under it a country that sees fit to tax its own ships two or three dollars per ton may tax ours the same, while if we exempt our own vessels we will be compelled to exempt hers. The only objection to the remedy proposed is that it would require revision of many of our treaties. A much simpler remedy would be the total abolition of tonnage duties. Restrictive and discriminating duties upon shipping are not in keeping with the spirit of the age. They answer no purpose except to oppress our shipping. They are relics of the last century when it was thought necessary for a state to annoy, as much as possible, the shipping of every other state, but the amendments to the statutes establishing these duties, and our treaties with other powers, have diverted them from their original purpose to a discriminating tax upon American shipping. The loss of revenue that would ensue from their abolition is altogether too paltry to be considered. Abolish tonnage duties and American shipping will have one less exaction to grumble about.

With cheap ships, light taxes and no tonnage duties, American shipowners will have but two or three disadvantages to contend against that it is in the power of the government to remove. First

among these, as being easiest of removal, is that of excessive consular fees. A secretary of state occasionally points with pride to the fact that our consular service is self-supporting. He means that it is supported by our shipping. Last year the amount received in fees at our consulates was $745,000, while the amount paid for salaries and fees was only $450,000. Our total registered shipping was 1,314,000 tons. Supposing all this shipping to have contributed this $745,000 in fees, our shipping will have paid for the support of this service a tax of 57 cts. per ton. *All* of our registered shipping did not contribute to this sum, nor was all of it received from that source, but each figure would be reduced in about the same proportion, so that we may fairly take 57 cts. per ton as the average paid by each ton of American shipping for the support of this system. Some of this tax is undoubtedly just, other very unjust. The consul is equally the servant of the government and of the commercial and shipping interests of its people. As the first, his duties are numerous and important, varying greatly with his post. He is everywhere an aid in the enforcement of the customs laws of the United States; in barbarous and semi-civilized countries his powers are very extensive; he is charged with the preservation of order among his fellow-countrymen; he is both judge and jury for the trial of civil and criminal cases; he is frequently the only diplomatic representative of the United States in the country where he is stationed. Why should American shipping be compelled to pay him for these services?

In addition to these duties to the government, the consul is charged with the performance of certain duties toward the shipping and commerce of the United States. He authenticates signatures; grants certificates of various kinds; administers oaths; ships and discharges seamen; receives and delivers ships' papers; and settles disputes between masters and men. Certain of these acts are required by law, others only when requested by the ship-captains. Let us have at least an equal division of the cost of this service. Let the government pay its share, and our shipping will have no cause of complaint on this ground. The British consular service, filled with men compared with whom our consuls are, in general, neither efficient nor admirable, is supported in the most liberal manner by the government, while the fees are merely nominal. The result is that the British consul, wherever one goes, is a gentleman, an honest, zealous servant of his country, secure in his position and certain of advancement according to his merits, while British ships enter and

clear at foreign ports without any delay and at trivial expense. The British consulate is always one of the finest places in the city, and famous for a hospitality that is not the least of the influences that gives its host the political power he usually has with the authorities. The American consul is too often a man who has received his office for services hardly consistent with the upright, dignified character most becoming in a consul. He is usually selected without reference to his qualifications (Guiteau aspired to a consulate); is naturally totally unfitted for that social prominence that is everywhere recognized as one of the most important factors in successful diplomacy, whether on a large or small scale. And were he a Chesterfield, what could he do in an American consulate with an American consul's salary? Cases have been altogether too frequent in which he has tried to make the shipping supplement his scanty income. One of the most fertile causes of fraud and, at the same time, one of the greatest injustices to American shipping, is the law requiring men discharged in foreign ports, under certain circumstances, to be paid three months' extra wages. Our shipping must not only support the consuls, but destitute American seamen as well. And as all men regularly shipped on American vessels are considered as American seamen, our shipping has to support destitute seamen of all nationalities. American ships entering foreign ports are required to deliver to the consul the ship's papers, and to pay him for receiving and returning them a fee of one cent per ton of the vessel's measurement, if less than one thousand tons, and a half cent additional for every ton over one thousand, should it exceed that measurement. British ships pay nothing for receiving and delivering the ship's papers. It costs an American ship just twice as much to ship or discharge seamen as it does British ships. In fact, with one or two unimportant exceptions, American ships pay twice as much for everything that the consul does for them as British ships do for the same things, while the fees required by consuls of the former are much more numerous than those required of the latter. It will probably be greatly in excess of the actual amount, but for want of accurate information as to the total fees paid per year by British shipping to consuls, we will estimate the amount per ton at one-half that paid by American shipping. Our American line, supposing it to have five steamers of thirty-five hundred tons each, will pay for the support of our consular service at 57 cts. per ton, a tax of $9,975, while an equal English line will pay but half that, or $4,987.

With regard to the relief of distressed seamen, the law provides that seamen shall be paid three months' extra wages, 1st. When a ship is sold abroad and her crew discharged; 2d. When a seaman is, with his own consent, discharged in a foreign country; 3d. When a vessel is condemned by inspectors; and 4th. When the seaman is discharged because the voyage is continued contrary to his agreement. Of the three months' wages thus paid, two-thirds are for the man and one-third for the government. The man's two-thirds are to be expended by the consul for his support on shore until he can be sent home. Should it not all be expended in this way, the remainder is to be paid him at his departure. The expenditure of this two-thirds has been productive of fraud in more instances than one. Collusion between consuls and boarding-house keepers has not usually resulted to the pecuniary advantage of the men.

Of the four cases in which three months' extra wages are to be paid, the first and fourth are those in which the ship ought properly to be compelled to support the men until they can be sent home. When a ship is sold abroad and her crew discharged, and when the voyage is continued contrary to the seaman's agreement, the three months' extra wages may be justly demanded. The second case is one that gives rise to frequent injustice to shipowners, and, on account of the latitude allowed consuls in deciding whether or not seamen should be discharged, to frequent abuses and frauds. With regard to the the third case, when a vessel is condemned by inspectors through fault of the master or owners, the extra wages may be justly demanded; but is it justice to compel a ship rendered unseaworthy by gales that wreck the staunchest ships and baffle the judgment of the most skilful captains, to support a lot of men of all nationalities, who have no claim upon her, and through whose very inefficiency or neglect the ship may have been wrecked, and who may be discharged within a stone's-throw of their own homes? Why should the shipping more than any other industry be compelled to support its discharged employés until they can find work?

Let the government charge itself, and not its shipping, with the support of destitute seamen; let the tonnage dues for receiving and delivering ships' papers be abolished; let all other consular fees be reduced at least one-half; and let the government appropriate liberally for the support of the consular service, and send out as consuls only men whose intellectual and moral qualifications have been carefully ascertained, and American shipping will receive another "subsidy" to which no one will object.

These things being done, American shipping will have but one serious disadvantage to contend against. They will still have to pay more for their labor than their rivals. This will be more especially the case with regard to officers, which are required by law to be Americans, but will be to a less degree true with regard to seamen, because in American ports, where the crews of most American ships are engaged, the prices paid for seamen's labor are, like those paid for other labor, higher than those paid abroad. Were the American seaman as superior to all others to-day as he was forty years ago, our ships would suffer no disadvantage from being restricted to American officers; but such is unfortunately not the case, for, while other nations are adopting every means to increase the efficiency and elevate the standard of their officers and seamen, we are doing nothing. The captain of a large American ocean-going steamer receives four thousand dollars per year; the captain of an equal English one but two thousand. The first officer of the American steamer receives one hundred and twenty-five dollars per month; of the English, eighty-five dollars. The difference between the pay of the junior officers is not so great as this, but it is enough to make the officers' pay-roll of an American ship at least twenty-five per cent. greater than that of an English ship of the same tonnage. The officers' pay-roll of an English steamer of thirty-five hundred tons foots up about twelve hundred dollars per month; of an equal American ship, fifteen hundred. This makes the difference in favor of the English steamer three thousand six hundred dollars per year, in this single item of officers' pay. If, for this greater pay, American ships get better service, as they did forty years ago, no disadvantage can result from this element of pay; but they do not. The remedy for this loss is, not to permit American ships to get their officers where they please, but to adopt measures to increase the efficiency of our officers and seamen, so that, for their twenty-five per cent. better pay, they will do, as they used to, fifty per cent. better work than their rivals of other nations. The establishment of school-ships for the training of both officers and seamen, in connection with the passage of an act requiring all ships to take apprentices from the school-ships in numbers proportionate to their tonnage, would be the simplest and most efficacious method of remedying this disadvantage of greater cost of labor.

There are other exactions and oppressions of which our shipping complains, such as excessive compulsory pilotage, the more expensive

ration required by law to be given our seamen, and higher interest and insurance charges, but with the exception of compulsory pilotage no remedy can be suggested for these disadvantages. Compulsory pilotage should either be abolished or the fees reduced to about one-fourth what they are at present. When, as was stated by a ship-owner not long ago, the pilot who takes a large steamer into New York harbor receives more for his services that her master does for taking her to Cuba and back, it is time something was done.

Let the disadvantages that result from greater first cost, greater tonnage duties, higher consular fees and labor, and compulsory pilotage be done away with, and American steamers will be able to enter the field of competition with a reasonable prospect of success. To summarize these exactions, let us suppose equal English and American lines running from home ports to some common foreign port. Suppose each line to have five steamers of thirty-five hundred tons each, the English line costing $2,000,000 and the American line fifteen per cent. more. We will take the interest charge for both lines the same, although the English line would probably pay one or two per cent. less than the American, which would increase the difference in favor of the English line by from twenty to forty thousand dollars.

The following table shows the discrimination against the American line from the causes discussed:

English Line.		American Line.	
Interest on investment at 6 per cent., . . .	$120,000	. . . . . .	$138,000
Repairs, insurance, etc., at 6 per cent., . . .	120,000	. . . . . .	138,000
Taxes at 2½ per cent. on net profits of 5 per cent., . .	2,500	At 2½ per cent. on 60 per cent. of cost, .	34,500
Tonnage duties . . .		At 30 cts. per ton, .	5,250
Consular fees at 28½ cts. per ton,	4,987	At 57 cts. per ton, .	9,975
Support of destitute seamen .		3 months' extra wages at $20 to 5 men each trip for 24 trips, . .	7,200
Pay of officers, . . .	72,000	. . . .	90,000
	$319,487	. . . . .	$422,925
Difference in favor of English line,		. . . .	$103,438

The American line would therefore be running at a loss when the English line was making five per cent. profit. Absolute accuracy

cannot be claimed for this table, but it is believed that the correction of any errors that may exist would still further increase the difference in favor of English ships.

The cause of the present decline of our merchant shipping may be assigned to the difference that exists between the two sides of the above table, and the remedy for the revival is to make this difference equal to zero.

There is room for great diversity of opinion as to how this may best be done. I have only attempted to indicate the methods that seem to me most practicable.

NAVAL INSTITUTE, ANNAPOLIS, MD.

MARCH 9TH, 1882.

COMMANDER H. B. ROBESON in the Chair.

POST-GRADUATE INSTRUCTION IN NATURAL HISTORY, FOR NAVAL OFFICERS.

By CHAS. E. MUNROE, PROF. U. S. N. A.

In January last a post-graduate course in natural history was inaugurated by the detailing of six midshipmen to duty at the National Museum as assistants to Prof. Baird, by whom they were assigned to the care of the different Curators. The suggestion of the writer was made operative through the earnest efforts of Rear Admiral C. R. P. Rodgers and the active coöperation of Commodore John Walker, and it met with the hearty approval of the Hon. Secretary of the Navy. Although at first Prof. Baird feared that the plan might fail, owing to the detailing of unsuitable men, still he was willing to give it a trial and to permit them to come. It is a pleasure to say that now, after some months' trial, the midshipmen ordered have pursued their studies with such diligence and application, and have performed the duties assigned them so intelligently and faithfully, that the course meets with his entire approval.

As the officers of the Navy may be interested to know how this course was set on foot and what objects it seeks, the subjoined letters of recommendation and approval are published. It may be well to call attention here to the fact that it is not intended, and, in fact, it is quite impossible in the time assigned, to make scientific experts, yet it is hoped to make broader men and, consequently, better officers of these midshipmen, while they are still employed in rendering services of great usefulness to the government, at a time when they can best

be spared from their regular duties. It is believed, too, that in the time assigned they may gain enough acquaintance with the subject to enable them to observe and record the natural phenomena with which they may meet while in the regular pursuit of their profession.

U. S. NAVAL ACADEMY, *October* 1, 1881.

SIR :

I respectfully beg leave to lay before you for your consideration the following plan for the mental improvement of the younger officers of the Navy, in the hope that, if it meets with your approval, an opportunity may be given them for the pursuit of the studies suggested.

Yours, very respectfully,
CHAS. E. MUNROE,
Prof. of Chemistry.

To HON. WILLIAM H. HUNT,
Secretary of the Navy.

U. S. NAVAL ACADEMY, *October* 1, 1881.

SIR :

During my connection with the service I have had frequent opportunities for observing the advantages which would result to naval officers from possessing some knowledge of natural history. While in the ordinary practice of their profession it might serve only as an improving pastime, yet when sent, as they often are, on expeditions to unfrequented lands, it becomes very useful, and when engaged in the work of the Coast Survey and the Fish Commission, and in surveys of the ocean bottom, such knowledge is essential to complete efficiency. Very few officers, however, are acquainted with this branch of knowledge ; but the ignorance which prevails is not due to a lack of either aptitude or inclination, for there are many officers who would prove successful in its pursuit, and I know that it is an almost universal source of regret, on the part of those who are sent on expeditions of research or discovery, that they have not such a knowledge of some branch of natural history as would enable them to study intelligently the land or water they might explore. This ignorance prevails solely because of the lack of time and facilities for the study.

I have for some years sought for the means by which both of these difficulties could be overcome. For reasons, with which you are thoroughly familiar, I became convinced that it was impracticable at present to extend the course of study for cadets at the Naval Academy in this direction, and that, consequently, the study must form a post-graduate course. Hitherto various difficulties have prevented the establishment of post-graduate courses for the Navy, except at the Torpedo Station, but the circumstances are now such that, in my judgment, a course in natural history is perfectly feasible, for, since the completion of the National Museum, the collections which have been gathered and stored in the Smithsonian Institute have been opened and are rapidly being arranged so as to be accessible for study. Knowing that it is the desire of the directors of the Museum to make these collections as useful as possible in the dissemi-

nation of knowledge, I have consulted with Prof. Baird as to the desirability of admitting naval officers to their study, and I am pleased to report that he believes that it would fulfil one of the objects for which the Museum is established, and that it would be of great benefit both to the service and to science, and that his assistants will cheerfully coöperate in directing the officers' studies.

Owing to the slowness of promotion, the lower ranks are being filled with men who, finding their positions irksome and their duties monotonous, naturally become dissatisfied and lose their professional enthusiasm and ambition. As it is difficult to find suitable shore duty for them, there is danger of their contracting habits during their periods of enforced idleness, which will to a degree unfit them for the duties and responsibilities which will devolve upon them when they reach the higher grades. In order, then, to fit these younger officers for a greater degree of usefulness and at the same time to remove the dangers that now threaten them, I would suggest that they be ordered to the National Museum for a period of one year or eighteen months, as assistants to Prof. Baird, to be assigned by him to duty in the several departments, just as officers of the Navy are now ordered. It would not, of course, be wise at this time to order a large number of men for this duty, but I would suggest that Prof. Baird be requested to state what number could be usefully employed, and that it then be announced that the members of a certain class would be allowed to apply for this duty, and that from among the number of applicants the desired number would be selected.

In making this selection it would be necessary to inquire into the ability, aptitude and application of the officer, and the purpose which leads him to seek this duty, for it is of the first importance that no one be ordered who seeks the position because of the social or other extraneous advantages which Washington affords. Prof. Baird dwelt especially upon this point, stating that a disregard of it would prove fatal to the success of the plan. Only such men are desired at the Museum as are thoroughly in earnest and ready to do serious work.

The most feasible way for selecting suitable men would be by means of a board of examiners, and I would suggest that a board consisting of the head of the Department of Navigation, the head of the Department of Physics and Chemistry, and the Professor of Chemistry at the Naval Academy, be ordered for the examination of applicants. I suggest this composition because the officers named are engaged in instruction in various branches of natural science, and should be able to recognize the qualities in an applicant which fit him for the study of natural history. In addition they are more or less acquainted with the career of the applicant, both while at the Academy and in the service. It may also be considered advantageous to add to this board an assistant from the National Museum and an assistant from the Coast Survey, selected by their respective chiefs.

Prof. Baird will be able to receive these assistants in October, and should you approve of this scheme I would respectfully recommend that it be tried as soon as practicable, and that the members of the class of Cadet Midshipmen

who graduated at the Naval Academy in 1879, and who have finished their two years of probation at sea and successfully passed their final examination, be allowed to apply for this duty. I know that from among its members a sufficient number of suitable men could be obtained. Not more than six (6) could be profitably employed at present, but I believe that with this number such results may be obtained as will lead to an increase of opportunities in the future.

Should this plan, which I have the honor to lay before you, meet with your approval, I would be pleased to assist in any capacity in putting it into execution.

Respectfully submitted,

CHAS. E. MUNROE,

Prof. Chemistry, U. S. N. A.

To HON. WILLIAM H. HUNT,

Secretary of the Navy.

No. 228.

U. S. NAVAL ACADEMY,

Annapolis, Md., Nov. 10, 1881.

SIR:

I regret to say that a letter sent to me some time since by Prof. Munroe, of the Naval Academy, has remained an undue length of time in my possession, owing to the pressure of business at the beginning of the academic year.

Before leaving the Naval Academy I beg to present it to you with the strongest possible endorsement of my favorable opinion. The plan of Prof. Munroe seems to me an eminently practical one, and likely to be productive of great good to the naval service and to its scientific reputation.

I hope the Department may be pleased to give this scheme its support, and I shall be heartily glad if I can, in any way, aid in carrying it into effect. The opportunity described is certainly of very great value.

I am, very respectfully, your obedient servant,

(Signed) C. R. P. RODGERS,

Rear Admiral, Supt

HON. WILLIAM H. HUNT,

Secretary of the Navy,

Washington, D. C.

PROFESSIONAL NOTES.

NOTE ON SLADEN'S GUNNERY.

By Professor J. M. Rice, U. S. Navy.

The values of φ and φ' derived in the following note are given in *Major Sladen's Principles of Gunnery*, pages 74 and 75, London, 1879, with a reference to Mr. W. D. Niven's paper *On the Trajectories of Shot*, published in the *Proceedings of the Royal Society*, No. 181, Vol. XXVI.

The expressions for φ and φ' however, as obtained in Mr. Niven's paper, differ slightly from those quoted by Major Sladen and derived here.

The method employed in deriving these formulas is similar to that of Mr. Niven.

Putting $\varphi = \alpha - \psi$, equation (4), page 70, becomes

$$\frac{1}{u^3} - \frac{1}{p^3} = \frac{c}{g}\left(P_\alpha - P_{\alpha-\psi}\right)$$
$$= \frac{c}{g}\left[3\tan\alpha + \tan^3\alpha - 3\tan(\alpha-\psi) - \tan^3(\alpha-\psi)\right].$$

Expanding the last two terms as functions of ψ by Maclaurin's Theorem, we have

$$\frac{1}{u^3} - \frac{1}{p^3} = \frac{c}{g}\left[3\sec^2\alpha\,.\,\psi + \dots\right.$$
$$\left. + 3\tan^2\alpha\,.\,\sec^2\alpha\,.\,\psi + \text{terms involving } \psi^2\right],$$

or

$$\frac{1}{u^3} - \frac{1}{p^3} = \frac{c}{g}\left[3\sec^4\alpha\,.\,\psi\right.$$
$$\left. + \text{terms involving squares and higher powers of } \psi\right].$$

To obtain an approximate value of ψ, we omit all terms containing its square and higher powers; whence

$$\psi = \frac{g\cos^4\alpha}{3c}\left(\frac{1}{u^3} - \frac{1}{p^3}\right). \qquad (a)$$

Again, since q is the value of u when $\varphi=\beta$ [see equation (5), page 70], we have from (a)

$$\alpha-\beta=\frac{g\cos^4\alpha}{3c}\left(\frac{1}{q^3}-\frac{1}{p^3}\right); \tag{β}$$

whence

$$\psi=\frac{\dfrac{1}{u^3}-\dfrac{1}{p^3}}{\dfrac{1}{q^3}-\dfrac{1}{p^3}}(\alpha-\beta). \tag{γ}$$

The X Integral.

In equation (c), page 73, putting $r=cv^3=cu^3\sec^3\varphi$, we have

$$X=\frac{1}{c}\int_q^p\cos^2\varphi\frac{du}{u^2}. \tag{δ}$$

By Maclaurin's Theorem we have

$$\cos^2\varphi=\cos^2(\alpha-\psi)=\cos^2\alpha+\sin 2\alpha\,.\,\psi+\text{terms in }\psi^2; \tag{ε}$$

omitting the terms containing powers of ψ higher than the first and substituting in (δ),

$$X=\frac{\cos^2\alpha}{c}\int_q^p\frac{du}{u^2}+\frac{\sin 2\alpha}{c}\int_q^p\psi\frac{du}{u^2}.$$

Introducing the value of ψ from (γ), we have

$$X=\frac{\cos^2\alpha}{c}\int_q^p\frac{du}{u^2}+\frac{(\alpha-\beta)\sin 2\alpha}{c\left(\dfrac{1}{q^3}-\dfrac{1}{p^3}\right)}\int_q^p\left(\frac{du}{u^5}-\frac{1}{p^3}\frac{du}{u^2}\right).$$

Whence, integrating,

$$X=\frac{\cos^2\alpha}{c}\left(\frac{1}{q}-\frac{1}{p}\right)+\frac{(\alpha-\beta)\sin 2\alpha}{c\left(\dfrac{1}{q^3}-\dfrac{1}{p^3}\right)}\left[\frac{1}{4}\left(\frac{1}{q^4}-\frac{1}{p^4}\right)-\frac{1}{p^3}\left(\frac{1}{q}-\frac{1}{p}\right)\right],$$

and, putting $\dfrac{1}{q}-\dfrac{1}{p}=Q$,

$$X=\frac{Q}{c}\left\{\cos^2\alpha+\sin 2\alpha\,.\,(\alpha-\beta)\frac{\dfrac{1}{q^3}+\dfrac{1}{q^2p}+\dfrac{1}{qp^2}-\dfrac{3}{p^3}}{4\left(\dfrac{1}{q^3}-\dfrac{1}{p^3}\right)}\right\}$$

It is now necessary to obtain an approximate value of the fraction

$$f=\frac{\dfrac{1}{q^3}+\dfrac{1}{q^2p}+\dfrac{1}{qp^2}-\dfrac{3}{p^3}}{4\left(\dfrac{1}{q^3}-\dfrac{1}{p^3}\right)}=\frac{\dfrac{1}{q^2}+\dfrac{2}{qp}+\dfrac{3}{p^2}}{4\left(\dfrac{1}{q^2}+\dfrac{1}{qp}+\dfrac{1}{p^2}\right)}=\frac{p^2+2pq+3q^2}{4(p^2+pq+q^2)}.$$

Put $l = \frac{p-q}{p+q}$, whence $p = \frac{1+l}{1-l} q$. We now substitute this value of p in the expression for f and omit l^2 in the result, since l is a small quantity.

$$f = \frac{\left(\frac{1+l}{1-l}\right)^2 q^2 + 2\left(\frac{1+l}{1-l}\right) q^2 + 3q^2}{4\left[\left(\frac{1+l}{1-l}\right)^2 q^2 + \left(\frac{1+l}{1-l}\right) q^2 + q^2\right]}$$

$$= \frac{(1+l)^2 + 2(1-l^2) + 3(1-l)^2}{4[1+l)^2 + (1-l^2) + (1-l)^2]},$$

and, omitting l^2, we have approximately

$$f = \frac{6 - 4l + 2l^2}{4(3+l^2)} = \frac{3-2l}{6}.$$

Whence $$X = \frac{Q}{c}\left\{\cos^2 a + \sin 2a \,.\, (a-\beta)\frac{3-2l}{6}\right\}. \qquad (\eta)$$

Comparing the equations (ε) and (η), it is evident that the expression in braces may be put equal to $\cos^2\bar{\varphi}$, if

$$\bar{\varphi} = a - \frac{3-2l}{6}(a-\beta) = a - \frac{a-\beta}{2} + \frac{l}{3}(a-\beta)$$

$$= \frac{a+\beta}{2} + \frac{p-q}{3(p+q)}(a-\beta).$$

That is, we have

$$X = \frac{\cos^2\bar{\varphi}}{c} Q, \quad Q = \frac{1}{q} - \frac{1}{p}, \text{ and } \bar{\varphi} = \frac{a+\beta}{2} + \frac{p-q}{3(p+q)}(a-\beta).$$

The Y Integral.

In equation (d) page 73, putting $r = cu^3 \sec^3\varphi$ we have

$$Y = \frac{1}{c}\int_q^p \sin\varphi \cos\varphi \frac{du}{u^2}. \qquad (d)$$

Expanding by Maclaurin's Theorem, we have

$$\sin\varphi\cos\varphi = \sin(a-\psi)\cos(a-\psi) =$$
$$\sin a \cos a - \cos 2a \,.\, \psi + \text{terms in } \psi^2.$$

Applying to this integral the same process we applied to (δ), we have

$$Y = \frac{\sin\bar{\varphi}\cos\bar{\varphi}}{c} Q,$$

in which $\bar{\varphi}$ and Q have the same values as in the X integral.

The Time Integral.

Putting $r = cu^3 \sec^3\varphi$ in equation (i), page 72, we derive

$$dt = -\frac{du}{cu^3 \sec^3\varphi \cos\varphi}; \qquad \text{whence } T = \frac{1}{c}\int_q^p \cos^2\varphi \, \frac{du}{u^3}.$$

Substituting the value of $\cos^2\varphi$ from equation (ε)

$$T = \frac{\cos^2\alpha}{c}\int_q \frac{du}{u^3} + \frac{\sin 2\alpha}{c}\int_q^p \psi \,.\, \frac{du}{u^3}.$$

Integrating and introducing the value of ψ from the equation (γ)

$$T = \frac{\cos^2\alpha}{c}\,\frac{1}{2}\left(\frac{1}{q^2} - \frac{1}{p^2}\right) + \frac{(\alpha - \beta)\sin 2\alpha}{c\left(\frac{1}{q^3} - \frac{1}{p^3}\right)}\int_q^p\left(\frac{du}{u^6} - \frac{1}{p^3}\frac{du}{u^3}\right)$$

$$= \frac{\cos^2\alpha}{c}\,\frac{1}{2}\left(\frac{1}{q^2} - \frac{1}{p^2}\right) + \frac{(\alpha - \beta)\sin 2\alpha}{c\left(\frac{1}{q^3} - \frac{1}{p^3}\right)}\left[\frac{1}{5}\left(\frac{1}{q^5} - \frac{1}{p^5}\right) - \frac{1}{2p^3}\left(\frac{1}{q^2} - \frac{1}{p^2}\right)\right];$$

whence, putting $Q' = \frac{1}{2}\left(\frac{1}{q^2} - \frac{1}{p^2}\right)$, we have

$$T = \frac{Q'}{c}\left\{\cos^2\alpha + \sin 2\alpha.(\alpha - \beta)\,\frac{\frac{1}{5}\left(\frac{1}{q^5} - \frac{1}{p^5}\right) - \frac{1}{2p^3}\left(\frac{1}{q^2} - \frac{1}{p^2}\right)}{\frac{1}{2}\left(\frac{1}{q^2} - \frac{1}{p^2}\right)\left(\frac{1}{q^3} - \frac{1}{p^3}\right)}\right\}.$$

Denoting by f' the fraction in the right hand term, and reducing

$$f' = \frac{2\left(\frac{1}{q^5} - \frac{1}{p^5}\right) - \frac{5}{p^3}\left(\frac{1}{q^2} - \frac{1}{p^2}\right)}{5\left(\frac{1}{q^2} - \frac{1}{p^2}\right)\left(\frac{1}{q^3} - \frac{1}{p^3}\right)}$$

$$= \frac{2\left(\frac{1}{q^4} + \frac{1}{q^3 p} + \frac{1}{q^2 p^2} + \frac{1}{q p^3} + \frac{1}{p^4}\right) - \frac{5}{p^3}\left(\frac{1}{q} + \frac{1}{p}\right)}{5\left(\frac{1}{q} + \frac{1}{p}\right)\left(\frac{1}{q^3} - \frac{1}{p^3}\right)}$$

$$= \frac{2\frac{p^3}{q^3} + 4\frac{p^2}{q^2} + 6\frac{p}{q} + 3}{5\left(\frac{p}{q} + 1\right)\left(\frac{p^2}{q^2} + \frac{p}{q} + 1\right)} = \frac{2p^3 + 4p^2 q + 6pq^2 + 3q^3}{5(p+q)(p^2 + pq + q^2)}.$$

Putting $l = \frac{p-q}{p+q}$, whence $p = \frac{1+l}{1-l}\,q$, we have

$$f' = \frac{2\left(\frac{1+l}{1-l}\right)^3 q^3 + 4\left(\frac{1+l}{1-l}\right)^2 q^3 + 6\left(\frac{1+l}{1-l}\right) q^3 + 3q^3}{5\,\frac{2q}{1-l}\left[\left(\frac{1+l}{1-l}\right)^2 q^2 + \left(\frac{1+l}{1-l}\right) q^2 + q^2\right]}$$

$$= \frac{2(1+l)^3 + 4(1+l)^2(1-l) + 6(1+l)(1-l)^2 + 3(1-l)^3}{10\,[(1+l)^2 + 1 - l^2 + (1-l)^2]}\,;$$

whence $f' = \frac{15 - 5l + 5l^2 + l^3}{10(3+l^2)} = \frac{3-l}{6}$ (omitting l^2 and l^3).

Hence $T = \frac{Q'}{c}\left\{\cos^2\alpha + \sin 2\alpha\,.\,(\alpha-\beta)\,.\,\frac{3-l}{6}\right\}.$

On comparing this equation with (ε), it is obvious that we can express T in the form

$$T = \frac{Q'}{c}\cos^2\overline{\varphi'},\ \text{if}\ \overline{\varphi'} = \alpha - \frac{3-l}{6}(\alpha-\beta) = \alpha - \frac{\alpha-\beta}{2} + \frac{l}{6}(\alpha-\beta),$$

or
$$\overline{\varphi'} = \frac{\alpha+\beta}{2} + \frac{1}{6}\,\frac{p-q}{p+q}\,(\alpha-\beta).$$

REAR ADMIRAL JOHN RODGERS, U. S. N.

In Memoriam.

John Rodgers, the late Senior Rear Admiral on the active list of the Navy, died at Washington, D. C., on the 5th day of May, 1882, in the 70th year of his age.

He had been 54 years in the Naval Service, and to it had given the enthusiasm of his youth, the strength of his middle age, the judgment of his riper years, and his single minded devotion and rare wisdom always.

After many perils by land and sea, in battle and in storm, he died peacefully, in his own home, full of years and honors, and was gently laid to rest by weeping friends in his native soil; completing a life well rounded in usefulness and without a flaw. He reached the Scriptural measure of three score and ten, died in harness, worn out, but full of hope in the ceaseless struggle for something better.

He was President of the Naval Institute from January 1879 to January 1882, and this sad intelligence comes to us too late to give in this number anything more than this hasty expression of grief, but in a future number we hope to give a careful and extended sketch of his life.

The purpose of this Institute is to elevate the character of the Naval Service, and this cannot better be done than by lessons learned from a life so useful, so honorable, so grand in simplicity, and so complete.

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NAVAL INSTITUTE, ANNAPOLIS, MD.

RULES FOR THE CARE AND HANDLING OF CHRONOMETERS.

By T. S. and J. D. Negus, New York.

1. In carrying chronometers, the gimbals should be secured by the stay to prevent the chronometer swinging in the gimbals. Aboard ship the gimbals should be unstayed, that the chronometer bowl and gimbal ring may find their level, and the stay should be firmly secured back in its place by its thumb-screw to prevent its being accidentally shoved under, over, or into the slot in the gimbal ring.

2. In all cases when carrying or handling chronometers, it is vitally important to avoid giving them a quick circular motion in a horizontal plane, unless it be to start them after having run down. A chronometer should not be given a circular motion on its vertical axis, whilst running, of 360 degrees in less than ten seconds, or a less number of degrees in less than a proportional time.

The balance of a properly constructed chronometer vibrates, when the instrument is clean and fresh oiled, one and a quarter turns (450°), or five-eighths of a turn (225°) on each side of its point of rest. It

receives an impulse from the main spring acting through the train of wheels from the escape wheel at each double vibration, occurring each half second, which is the change of time shown on the dial for the forward and backward swing of the balance. If the chronometer should receive a quick circular motion of a trifle more than three-eighths of a turn to the right as the balance was about completing its vibration to the left, or *vice versa*, the effect would be that the escape wheel would be relieved by the lifting of the spring detent by the discharging pallet on the balance staff, at each end of the forward vibration, as well as at its centre, the balance thus receiving three impulses from the escape wheel for each double vibration, instead of one as designed. The dial would therefore show a change of one and one-half seconds instead of one-half second, as the double vibrations of two turns or more are each performed in the same time as if of one and a quarter turns each. The immediate effect on the chronometer would be to increase its error from one to fifty seconds, according to the violence and extent of the circular motion, the balance not dropping immediately to a vibration of less than two turns, on account of the additional impulse it receives from the escape wheel.

The general after-effect is for the chronometer to lose on its previous rate from a few tenths to one second per day, presumably on account of the extra strain on the balance spring having destroyed or temporarily changed its elasticity. Chronometers generally regain their previous rates in one or two weeks, provided the balance spring is well tempered.

These results rarely occur, and not at all if persons handling chronometers use ordinary care and avoid giving them a quick circular motion on their vertical axes. A swift motion forward or sideways will not affect the error or rate of a chronometer if unaccompanied by concussions or jars. We believe that a chronometer balance is more frequently overturned by lifting the instrument from a high level, such as a shelf or table, by the strap and twisting it suddenly to a natural position at the side for carrying, or in lifting it from the side to a higher level, than in any other way.

3. Aboard ship the chronometer should always be kept in its outside case, which should be firmly screwed down amidships in a well ventilated apartment, yet free from currents of air, and should not on any account be placed near wood which is in contact with salt water. The outside case should be kept closed except in marking time and winding, in order to protect the chronometer, so far as possible, from

sudden changes of temperature and from the injurious influence of salt air. It is advisable in a damp or moist climate to further protect chronometers by wrapping a heavy dry woollen blanket around the outside case, changing it as often as may be necessary to preserve its dryness. On no account should chronometers be taken from their outside cases for deck observations; for such a purpose a hack chronometer or comparing watch should be used.

The reason for these precautions is found in the fact that rust on the steel works of the chronometer is always injurious, and on the balance spring is immediately fatal to its rate. A small spot of rust on the balance spring, barely discernible, will cause a chronometer to lose from one to five seconds per day, and the error will increase as the rust eats into the spring. It is therefore necessary to protect chronometers in every possible way from the injurious effects of salt air and from dampness in every form.

If the chronometer is cold and it should suddenly be exposed to a warm damp current of air by leaving the lids of the case open, moisture will be deposited on the outside of the bowl. If the chronometer is warm and a cold current of air strikes it, moisture will be deposited on the inside of the chronometer if the dew point is reached, which, of course, depends on the hygrometric state of the air inside the bowl. If near saturation, a sudden fall of a few degrees in temperature would cause a deposit of moisture.

We would here remark that, in our experience, chronometers in use in the government service are much less liable to become rusty than are those in our mercantile marine. This is probably due to better general care, and to their being used in larger and better ventilated vessels, which are freer from bilge air and do not carry cargoes that sweat or throw off corrosive vapors. We have known cases in which vessels invariably rusted every chronometer that was used aboard in a short time, but the evil was readily cured by wrapping a dry blanket around the chronometer and changing it each day.

We believe the general custom in United States naval vessels is to place the chronometers in an outside case provided by the Navy Department, lined and padded with curled hair to protect against jars, and made to contain two or more chronometers. The outside cases provided by the makers are made in this way, and are used in the merchant service for protecting the chronometers from salt or damp air, but in the government service they are used as transporting cases.

4. Chronometers that are constructed to run fifty-four or fifty-six hours should be wound daily, at or about the same hour. Chronometers constructed to run eight days should not be wound daily, but only once a week. In winding, turn the chronometer bowl over in the gimbal slowly with the left hand, slide the valve by pressing the forefingers of the left hand against the nail-piece on the valve until the keyhole is uncovered, insert the winding key with the right hand, and wind to the left until a decided stop is felt. After removing the key, do not let the chronometer bowl swing of its own accord to its level, but let it down carefully until horizontal.

5. Chronometers should never be placed near enough to magnets, compasses or electro-magnets to be under magnetic influence.

6. To start a chronometer running after it has run down, or after it has been wedged for transportation, avoid altering the position of the hands, if possible, by waiting until they indicate the proper time, and then start it by a circular motion of about one-half a circle in the plane of the dial.

7. In transportation of chronometers overland by rail, when they are not at all times in care of a special trustworthy messenger, who understands the character of the instrument and the necessity of carrying it as described in § 2, the balance should be stayed. This can be done as follows: Stay the bowl and ring, unscrew the bezel, place the thumb and fingers of the left hand over and around the edge of the dial, but avoid touching the hands; turn the chronometer over with the right hand, when the movement will drop out of the brass bowl into the fingers of the left hand. Bring the balance to rest by a piece of light paper gently applied to the outer diameter of the balance. Then stay the balance with two thin cork wedges made of new cork slid gently underneath the rim of the balance, on opposite sides, to the right of the horizontal bar of the balance, but close to it. Avoid touching the timing screws with the wedges.

Chronometers are frequently seriously damaged by the balance having been corked for transportation by inexperienced persons. Damage may result by their using old cork impregnated with acid, thereby causing rust on the steel part of the balance, or by *shoving* thick lumps of cork underneath the free end of the rims of laminæ of the balance with such force as to bend the laminæ and sometimes the balance staff pivots. We therefore advise that whenever possible chronometers be prepared for transportation by chronometer makers. In cases where their services cannot be obtained, it can be done by others than experts by carefully observing the proper precautions.

It is important that the thin cork wedges should not be placed under the rim of laminæ of the balance at the free end, but close to the horizontal bar, and that they should be shoved under with only force enough to stay in place and hold the balance steady without exerting a strong pressure against the rim of the balance or the balance staff pivots, which are only 0.0045 of an inch in diameter.

For transportation by express, chronometers should never be packed in a box as ordinary merchandise, but should be sent in their own outside or transporting cases, marked "chronometers, handle by strap with care." In this way they are treated with some degree of care by express messengers, as the character of the instrument is shown. Our experience has been that, when transported overland packed as merchandise, they are invariably damaged from rough handling received.

8. Chronometers that have been transported on land, either with the balance corked or otherwise, should be re-rated, if possible, before being sent on sea service. In cases where there is not time to re-establish rates and errors before going to sea, they can be transported, running, with but slight chance of change of rate or error, as follows: Remove the bowl from the gimbal ring by unscrewing the front pivot screw of the ring, wrap the bowl in large sheets of soft paper, and place it in a basket of rectangular shape, with soft cotton or hair packing around it, with dial upwards and as far removed from the vertical axis of the basket as possible. Send the basket by special messenger, to be carried by the handle. The boxes and gimbals of the chronometer can be forwarded otherwise. Chronometers transported running in this way will not be liable to the jars of transportation, owing to the lightness and elasticity of the basket and packing, and the balances will not be liable to overturn if the basket is given a circular motion, as they are not situated in the vertical axis of the basket.

Compensation for Temperature and the Errors of the Ordinary and other Compensation Balances.

In every chronometer with the ordinary balance, there is a temperature at which it has its greatest gaining or least losing rate, or, in other words, a temperature at which it goes the fastest.

The chronometers of our make, in use in the U. S. Navy, are compensated to have their greatest gaining rate at or about a temperature of 70° F. It probably would not vary five degrees from that point in any

chronometer in good working order. In a few cases the fastest rate might be between 65° and 70°, but seldom or never above 72° F.

The average temperature correction is 0.0025 sec. multiplied by the square of the number of the degrees from the temperature at which they have the fastest rate, or calling t the number of the degrees from 70°, correction $= -0.0025t^2$ seconds.

Thus a chronometer with a rate of +1 sec. at 70° would theoretically show the following rates at other temperatures above or below 70°:

55°	60°	65°	70°	75°	80°	85°
+0.4375 s.	+0.75 s.	+0.9375 s.	+1.0 s.	+0.9375 s.	+0.75 s.	+0.4375 s.

thus showing an extreme variation of 0.5625 s. in a range of 30°. If the fastest rate had been at 85°, the difference of rate at 55°, the same range as in the first case would have been -0.0025 s. $\times\ 30^2 = -2.25$ s., and the same difference would have existed at 85° if the fastest rate was at 55°.

The ordinary balance is the compensation balance in general use for correcting the chronometer for changes of temperature, preventing errors from arising from the contraction or expansion of the balance spring. Without compensation the change of rate would be about six minutes a day for a range of 60° in temperature. With but few exceptions the chronometers in use in the U. S. Navy have the ordinary balance. Many balances of other forms have been designed and made, for the purpose of obtaining a more accurate compensation for a greater range of temperature, but, thus far, all such can be considered experimental only, and have not been introduced by the makers, ourselves amongst the number, into their chronometers of commerce. Some of these modifications have shown more or less favorable results for limited periods of time in observatories, or where stationary and not exposed to the hardships and rough usage incidental to sea service or transportation.

Probably in no other direction has there been so much time and thought given in the last thirty years, and so little accomplished, as in the effort to improve on the ordinary compensation balance. Many have been invented for which great claims were made, but most of them have passed into oblivion, having been used by the maker to establish a reputation from short trials in observatories under favorable circumstances and with no thought of adopting them in the chronometers of trade.

The ordinary balance has stood the test of time, and when properly made and adjusted is more serviceable than any of the auxiliary compensations, or any of the improved forms yet invented. The former are uncertain in their action, unstable, and subject to disarrangement from various causes; the latter show sea rates widely different from the shore rates, the error being occasioned by tremors produced by the action of machinery or waves, or both, and varying in accordance with the amount of tremor thus produced. When chronometers with properly made ordinary balances fail to give satisfactory results under ordinary ranges of temperature, it is from their having been left by the maker with their fastest rate at too high or too low a temperature, either from carelessness, ignorance, or for lack of facilities for obtaining artificial temperatures for adjusting them. We frequently find chronometers, otherwise well made, that have their fastest rate as high as 120° F. or higher, or as low as 32° or lower. We adjust our chronometers to have their fastest rate as near 70° as possible, on the theory that they are not liable to be exposed to an average temperature of over twelve or fifteen degrees above that point for any great length of time, and that they can and should be protected from a temperature of more than fifteen degrees below it. In special cases, such as a voyage to the Arctic regions, they should either be specially compensated for low temperature, or have their temperature correction applied.

For ordinary cruising in the temperate or the torrid zones we think it as well to neglect the temperature corrections, except in unusual cases, where the chronometer had been exposed to great extremes of heat or cold for a considerable length of time between ratings. In all cases chronometers should have their errors corrected, and their rates re-established at every convenient opportunity.

Of the chronometers in service at sea throughout the world, probably 99.99 per cent. have the ordinary compensation balance. But few of the many thousand chronometers of various makes that have passed through our hands in the course of forty years' business have been of different form, or with auxiliary attachments, and have in all cases been the most unreliable, showing errors greater than those due to the ordinary balance.

On Cleaning.

Chronometers should be cleaned and fresh-oiled every three and a half years, and sooner if they show unsteadiness in their rates,

having previously been regular. This would prove, either that the oil had dried or gummed, and that the pivots were cutting, or that there was rust on the steel works, and in such cases the chronometer should have the rust removed, and be cleaned and oiled as soon as possible.

There are many cases of chronometers performing well for five and six years, or even longer, without cleaning or oiling, but such cases are exceptional and should not be thought to establish a rule. CHRONOMETERS ARE THE BEST CARED FOR AND GIVE THE BEST RESULTS WHEN THEY ARE CLEANED AND OILED BEFORE THEY ABSOLUTELY REQUIRE IT, for the following reason: if they are allowed to run until the oil becomes gummed or dried, the arc of vibration of the balance, and consequently the action of the balance spring, becomes reduced from the increased resistance and wear of the pivots. The damage to the mechanical action can be repaired by repolishing the pivots, rebouching the holes, inserting new jewels, etc., but the balance spring receives injury, varying with the length of time it has been running below its normal action. This is shown after the chronometer has been cleaned and repaired, and the balance and balance spring restored to their original action, by its not settling to any permanent rate for a long time, and if a largely reduced action of the spring has been allowed to exist for a long time, the rate may never become permanent. In this case the only remedy is a new balance spring, which is expensive, requiring as it does a total readjustment of the chronometer for compensation for heat and cold, isochronism, etc., and with the disadvantage, moreover, that a chronometer with a new balance spring cannot be depended upon for two or three years. All new chronometers or chronometers with new balance springs have a tendency to gain on their rates if the spring is properly tempered.

We find this to be almost invariably the result when chronometers have been allowed to run for a long time with a much decreased vibration. Our theory of the bad defects shown after cleaning is that the elasticity and molecular cohesion of the balance spring had accommodated themselves to the reduced vibration, and that this adjustment was disarranged on the spring being restored to a largely increased action, by the molecules rearranging themselves in the new action suddenly forced upon them. This is more particularly shown in trials in changes of temperature. These defects are not shown equally before cleaning, as the decrease from a large to a small vibra-

tion is very gradual, being almost imperceptible between rates and partly compensated by the isochronism of the balance spring.

This injury from the chronometer running too long without cleaning or oiling is, in our opinion, frequently the cause of remark so often heard from shipmasters—"that their chronometer ran well for six years (or more) without cleaning, but since it had been cleaned by Mr. ———— it had never run well";—not realizing that it was their own negligence, in allowing it to run so long, that caused its subsequent bad performance.

On Oils.

The question of oil for a chronometer is a serious one, as the performance of the best made and best adjusted chronometer depends finally on the oil used.

The general custom among chronometer makers is to purchase oil from dealers without due regard to its nature and fitness for the purpose intended, discovering its unfitness only by the failure of the chronometer to which it is applied. Realizing thirty years ago the injury that might accrue to the reputation of our chronometers from uncertain oil, we resolved never to use any except such as we prepared ourselves from carefully selected crude material. When it is considered that there is less than one drop of oil divided among the ten least or smallest pivots and bearings of the chronometer, and that the balance, weighing about seven pennyweights, makes 126,144,000 vibrations of 450° each yearly on pivots the diameter of which is only 0.0045 in., to which not more than a thirtieth of a drop of oil can be applied, the importance of cleaning and oiling at least every three and a half years is evident. We dwell on this subject, inasmuch as persons owning or using chronometers are, as a rule, disposed to let them run for an indefinite length of time without cleaning or oiling, seldom giving the subject any consideration, unless their attention is called to it, and frequently allowing them to run until they stop from the pivots having been cut off. This is not fair or just to the chronometer, to the owner, or to the reputation of the maker.

The oil we use is obtained from the jaw of the porpoise (those caught off Cape Horn being the best), but is mixed with other oils to give it body when necessary. We procure this by urgent appeals to our seafaring friends, who catch the porpoise, extract the oil from the jaw only, and forward it to us before it becomes rancid, when we prepare it by methods of our own.

Oil suitable for chronometers should have the following qualities:

First. Freedom from acid or alkali.

Second. Fluidity and lubricating properties to allow freedom of action of the pivots in their bearings, while possessing sufficient consistency to stay where placed without spreading or running away.

Third. The property of not congealing at a very low temperature or of becoming too thin at a high one.

Fourth. The property of retaining its fluidity and lubricating power under the effects of friction, and of not gumming or drying up for a reasonable length of time.

To obtain these requisites for some of the pivot actions, we are frequently compelled to resort to a judicious combination of thick and thin oils.

NAVAL INSTITUTE, WASHINGTON BRANCH.

May 4, 1882.

Rear Admiral Daniel Ammen, U. S. N., in the Chair.

THE MARINE RAM, AS DESIGNED BY REAR ADMIRAL DANIEL AMMEN, U. S. N.

By Wm. G. Gibbons, Esq.,

President of the Pusey and Jones Co., Wilmington, Del., Iron Ship and Engine Builders.

From the earliest period in the history of the human race until the present time, the quarrels that have arisen between tribes, or provinces, or nations more or less contiguous, have in the main been settled by recourse to blows.

In the centuries long past, might alone was the gauge of right, and that people who were without skill or strength for their defence soon found themselves in the condition of vassals or serfs, rendering compelled allegiance to a conqueror.

During the times when mechanic arts were in their infancy, men fought with improvised weapons, and hand-to-hand conflicts were the order. When the wooden spear and the war club gave place to the metallic sword and steel-pointed lance, still struggles were decided only by personal encounter; but it is to be noted that, as skill in the working of brass and of steel increased, the element of distance between the combatants became a prime factor, and men evinced a hesitation to meet in a hand-to-hand struggle where one or both were sure to fall.

The question has been raised whether, as the means of destruction of life in battle increased, the number of those who thus ended their existence did not diminish in comparison with the times when wars

were mere sanguinary encounters, where strength alone, and not skill, decided the contests. Opinions differ as to this, but, nevertheless, the weight of evidence leans toward the conclusion that, with the improvements in the art of taking life, and the increase of facilities for its destruction, the number actually killed in war diminished in direct ratio.

When men first accustomed themselves to "go down to the sea in ships," the same hand-to-hand struggles that had been the rule between combatants on land obtained upon the water, and naval encounters were in the main decided by armed men from one vessel springing upon the decks of another, and the battles were not won by those who possessed the heaviest and largest vessels, but by those who had at their command the strongest and bravest crews.

When the discovery of gunpowder was given to the world and its application to naval gunnery became to some degree understood, the conditions of encounters upon the seas underwent a radical change, and battles were decided as much by the endurance of the vessels themselves, under the crushing action of shot, as by the skill and ability of those who commanded and manned them.

From that date until the middle of the present century, and indeed up to our own time, each advance in the capacity of ships to resist shot, or change in the detail of their construction, to the end that projectiles should strike with a minimum of injurious effect, has been closely followed by an advance in either the penetrating power of the guns or their capacity to discharge projectiles of greater weight, and consequently greater crushing force, or both of these; so that it is doubtful whether the relative position occupied by the ships on the one side and the guns on the other, one hundred years ago, has materially changed since, notwithstanding the fact that the naval forces of the great maritime powers of the world contain to-day iron-clad ships costing singly more than the entire fleet of war vessels owned by the United States Government at the time of the war with England in 1812.

The question then obtains, whether it is wise on the part of a nation to expend millions of dollars in building ships, able to carry upon their sides hundreds of tons of iron, in the effort to enable them to resist the shot of modern guns. The knowledge that these vessels, one and all, are relatively slow, dull in manœuvring, of doubtful seaworthiness, costly to maintain, and practically useless as cruisers, will supply an answer to the question.

The problem of supplying the best defence of the approaches to an important seacoast city against an enemy's vessels, and particularly those of the type of the modern ironclad ships belonging to the great nations of the old world, has been solved by Admiral Daniel Ammen, of the United States Navy, in the production of the Marine Ram, with which his name has been associated for many months past, the description of which being the subject-matter of this paper.

The Ram in question is in itself a projectile, and not a vessel intended in any respect to carry guns, or serve as a base from which projectiles shall be despatched.

The form of the Ram can best be understood by reference to the drawings accompanying this article. The dimensions are as follows:

Extreme length, ...	205 feet.
Extreme breadth, ...	36 "
Breadth of hull proper, ...	30 "
Total depth, ...	18 "
Draught of water, without coal or supplies, .	11 "
Deep loaded draught, ...	13 "
Displacement, ...	1400 tons

The vessel consists of a complete iron shell, whose cross section approaches the form of an ellipse, and the longitudinal midship section is not essentially different from that figure. It lies low in the water, and its upper and exposed portion is completely encased in deflecting armor securely laid upon a heavy wooden backing. The armor is regularly diminished over the crown of the deck, but for two feet vertically above the water line it maintains its maximum thickness of 3 inches.

The submerged portion of the armor increases in thickness from one inch at a depth of 5 feet 6 inches, to 3 inches at the apex of the sponson, where it and the convex armor of the deck meet in a sharp edge.

A cylindrical pilot-house of steel, 12 feet 6 inches diameter at outside and 20 inches thick, stands on the crown of the deck, sheltering the steersman, and protecting the smoke-stack which passes up through it.

The ship at forward end tapers uniformly to a point, and terminates in a heavy cast steel head. In this is mounted a removable point, or die of hammered steel, hardened and tempered. It is slightly cupped at the end, so as to present a chisel-like circumference, the intention

of this being that, should impact be had with an inclined surface, the die would not slip, but bite at the instant of contact, thus enabling the Ram to successfully strike an enemy's ship at an angle not less than forty degrees.

The hull is formed upon the bracket and longitudinal girder system. The girders are of plate iron, 20 inches deep, 20 in number, distributed all around the hull, and terminating forward on the cast steel head before referred to. This construction not only affords the greatest strength with the least weight, but running, as they do, fore and aft, and being directly attached to flanges on the cast steel head, the shock of a blow given, as a ram, is distributed thereby equally over all portions of the structure.

A double bottom runs the whole length of the ship; at a distance of 25 feet from either end is a water-tight partition formed of iron plating, completely separating the end spaces from the interior of the vessel.

Between these last are two longitudinal bulkheads, being, in reality, vertical continuations of the inner bottom, running fore and aft at a uniform distance of 3′ 9″ from the outer shell, thus adding greatly to the general strength of the ship, assisting in the distribution of the shock resulting from impact, and providing security against the work of torpedoes, or any contingency that would occasion a fracture of the outer shell of the vessel.

It is proposed to give to the Ram a speed of 13 knots per hour, this to be accomplished by the use of two independent, inclined surface-condensing engines, each driving its own propeller separately, and without any connection with the other.

The cylinders are 28″ diameter, 54″ stroke, working under a pressure of 100 pounds per square inch above the atmosphere. The propeller wheels are ten feet in diameter, the engines having a collective power of 1600 horses.

Steam is to be supplied by two cylindrical return tubular boilers 10′ 6″ diameter, with four furnaces each.

As has been before observed, the smoke-pipe passes through the interior of the pilot house, whose thick walls of steel are intended to protect the officer who directs the movement of the vessel in time of action, and to prevent the uncomfortable results that would follow the knocking away of the chimney at the line of the deck of a vessel, whose most elevated part, other than the pilot house, is but a few feet above the water level, and over which the tops of the seas would constantly pass.

To enable the movement of the Ram to be skilfully and properly directed, the walls of the pilot house are provided with angular openings or slots; the exterior portion measured vertically being an inch or about in width, while the interior part is scarcely $\frac{1}{16}''$ in aperture, the length of these openings measuring in direction of the circumference of the pilot house being several inches, and radiating laterally as well as vertically.

The steering apparatus will be operated by steam engines located below the deck, and either controlled and directed by a wheelsman placed in the pilot house, or by a properly arranged system of communication with a steersman below.

By reference to the accompanying drawings it will be observed that the deck is arched, both longitudinally and transversely, and considering in connection with this that the Ram lies low in the water, the difficulty of striking it with shot at other than lines closely approaching a tangent to the curve will at once appear.

At the sides the deck terminates on a V-shaped projection, measuring three feet beyond the vertical line, and presenting an angle of about thirty degrees to a broadside approach. This space is solidly filled with hard wood, the deck armor gradually thickening to six inches and ending in a heavy cap-piece, on which both side and deck armor join.

This V-shaped projection is carried all around the vessel, the penetrating portion of the ram being widest horizontally, and not vertically, as is the case with a majority of ironclad vessels of European navies, the effect being not only to add strength in the direction most required, but in the event of delivering a penetrating blow to a vessel in motion, the act of disengaging would tear and enlarge the opening already made.

While this vessel offers every facility for ramming another by reason of her form, and the extreme quickness with which she can be turned, thus enabling her to strike successive blows where necessary, her own construction is such as to enable her to either avoid or resist all ordinary modes of attack.

The pilot house by reason of its form and thickness may be regarded as nearly or quite invulnerable, and even in the improbable event of its being penetrated, the damage by no means unfits the vessel from ramming and sinking her antagonist.

The sharp edge of heavy iron presented at her sides renders her a dangerous vessel to ram, even should her great ability to turn quickly

permit her to be struck by an enemy's vessel at or near right angles; her retreating bilge is very unfavorable to successful assault by that method, and inasmuch as nearly seven feet of armor plates, timber and frames must be cut through before her vulnerable part, namely, the longitudinal bulkhead, can be reached, it is not improbable that before all these would yield to the blow given by a heavy ship, that a lateral motion would be given to the ram herself, to which end the particular form of the immersed portion of her hull would largely contribute.

Torpedo attack is provided against by her double bottom and double sides, and as the space between the inner and outer shells is in turn divided into chambers, of such size that a number may be solidly filled with water without endangering her ability to float, and as all these spaces are to be connected to powerful pumping apparatus, it would seem that danger from that method of attack is reduced to a minimum.

Her moderate length, double propellers, which may be worked in opposite directions at the same time, light draft, sharp cross section, reduce to a minimum the time required for turning, and, in the aggregate, result in producing as active a vessel as can possibly be constructed, and, possessing this quality, so very important in naval conflicts, she is enabled to avoid the attack of her enemies, and at the same time deal her own blows with precision and effect.

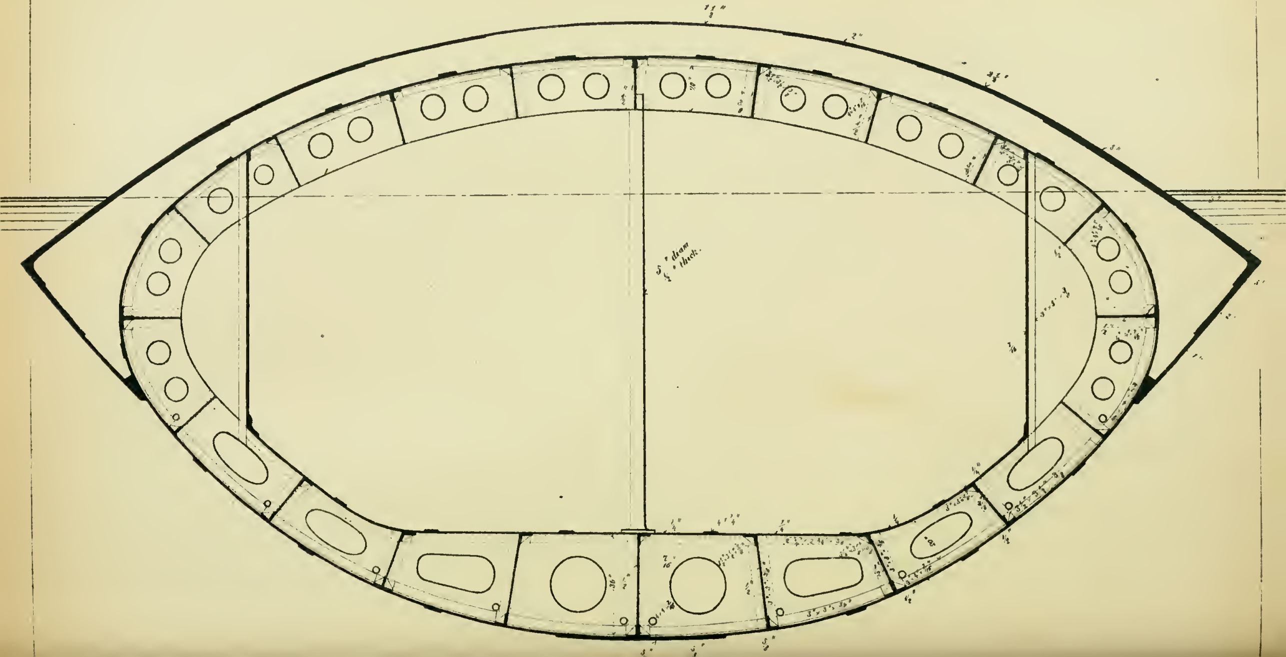
Her engagement with an ironclad ship of the type of the majority of those most prized by the transatlantic naval powers would be analogous to a combat between a sword-fish and a whale.

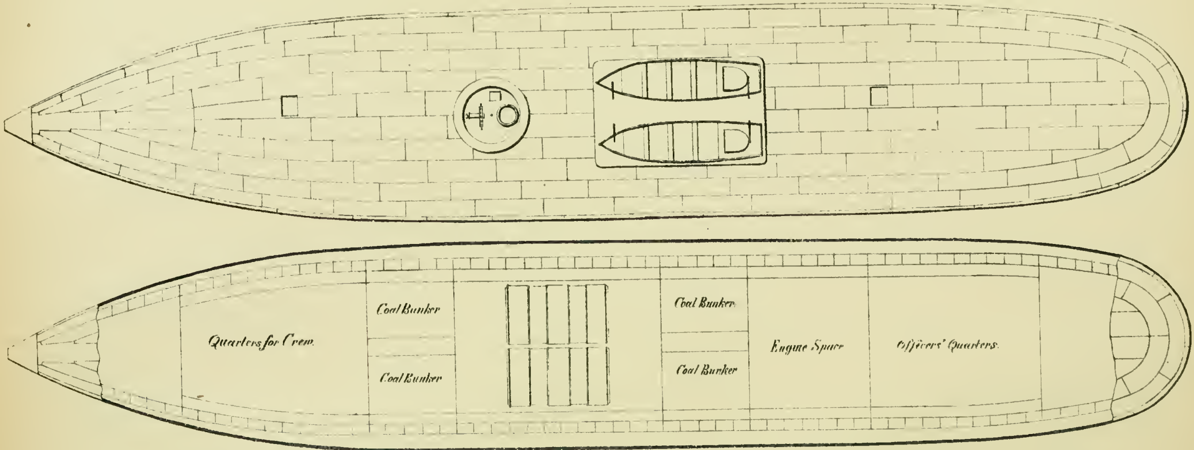
This Ram is not intended to be used as a cruiser. Its element of efficiency and great value lies in its ability to protect and defend seacoast cities from the attack of hostile fleets.

It may be urged that some of these are so heavily built and their sides so protected by thick armor, that a blow received from such a ram as has just been described would only result in destruction to the latter, just as if driven at full speed against a rock. It is doubtful if such ships exist, but if they do, they are manifestly vulnerable in this particular, that a blow from the ram delivered upon their propeller wheels, which could easily be done, would at once disable them, and surrender become a question of necessity.

For the defence of our American cities, the writer of this article is of opinion that nothing so practically efficient as the Ram herein described has yet been produced. The cost being small, not ex-

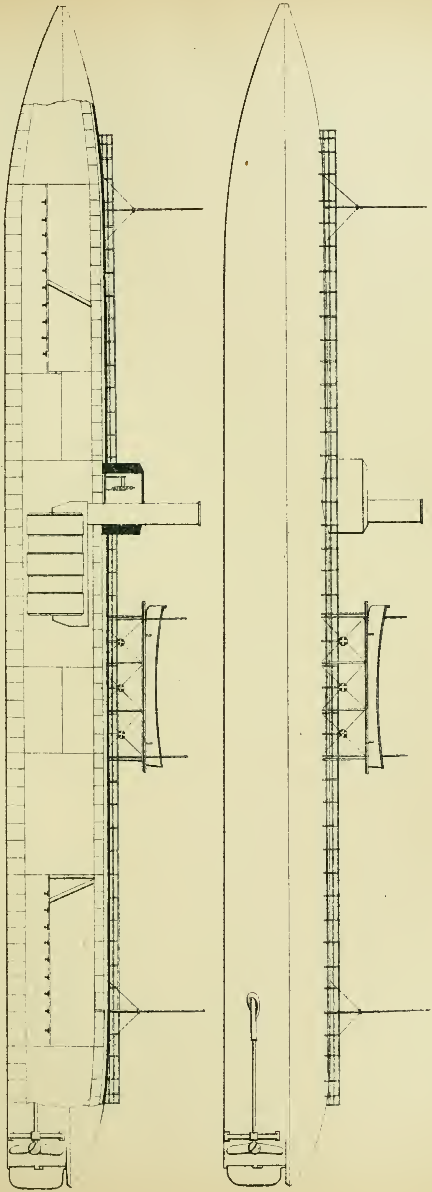
Iron Ram
Length, extreme 205 ft. Breadth, extreme 36 ft.
Depth, extreme 18 feet





Length, extreme	205 ft.	Armored Ram	Draught load.	13 ft.
Breadth, "	36 do.	The Pusey & Jones Company	Displacement,	1400 Tons.
Depth, "	18 do.	Wilmington, Del.	Two Engines.	28" x 54" Stroke.

Feby 6, '82.



ceeding $500,000 each, two or more could be devoted to the protection of each chief city. In time of peace they could be laid up in such manner as to undergo little or no deterioration, and with the certainty of being gotten ready when wanted, at but a few hours' notice. Their light draught would enable them to play around heavy, deep-water vessels, which of necessity would be compelled to proceed slowly in the well-known channels of approach, thus enabling them to deliver their blows upon the most vulnerable portions of the enemy's hulls.

DISCUSSION.

LIEUT. E. W. VERY.—There is a point with regard to the construction of the ram to which I desire to call attention, as it is one which not only has already aroused considerable attention, but which to my mind will soon become of much greater importance. That is the turtle-back deck. Mr. Gibbons has stated that the deck is to be of steel of a maximum thickness of three inches. Since there is at present much uncertainty with regard to the protecting qualities of a covered deck, I will submit for the inspection of the gentlemen here present a series of photographs of steel armor plates intended for deck plates of the Danish Torpedo Ram vessel Tordenskjold. These plates are 3½ inches in thickness, and the deck which they cover is of the turtle-back description. I will here state one of the articles of my belief, or religion, if you may so call it, with regard to armor, and that is, that steel armor is far superior to compound or steel faced. I look upon compound armor much as I do upon composite shipbuilding: very good, but not the best. No doubt there are many here who disagree with me, but in support of my belief I submit these photographs.

In the first place, as an economical appliance steel armor is, and necessarily must be, cheaper than compound, for the reason that less labor is incurred in the manufacture. Those who favor compound armor may say that the necessary qualities cannot be obtained in steel, but this I deny emphatically. I state, as a result of what I have studied and seen, that I firmly believe that steel is the most docile and intelligent metal in existence. Whatever can be done with any other metal can be done with steel, provided only that common sense be exercised in its manipulation. I show you here, first, a series of 3½ inch targets consisting of plates furnished by the best manufactories in the world. Here you see Krupp, Schneider, Marrell, Terre Noire and Land ore steel. Take the poorest results from any of these targets and it is superior to any iron target ever fired against. Compound plates must be excluded, as none are furnished so thin. In fact, the good qualities of compound plates are not developed on so slight a scantling. Let us examine the evidence of the machine tests of

these plates. The highest tensile strength given is 60,000 lbs. per sq. in., which gives comparatively a soft surface as compared with the chilled iron head of a projectile, or even a steel head. The lowest of the targets shows 47,000 lbs. The elongation runs from 14 to 30½ per cent. Now, steel plates of this kind can be furnished by any first-class steel factory in this country. It is impossible to furnish compound plates of any kind that would be of any account. Again, let us look at the results of the shooting. Against the Schneider plates the 3½ inch gun, firing a 15 lb. projectile, was powerless to develop even a crack on the rear surface at 300 yards, the blow being a normal one. Now, if such is the result at a vertical target, I ask you to think what it would be with the target nearly flat. At a rough estimate, this plate laid at an angle of 5° would be equivalent, as far as actual penetration is concerned, to over 40 inches of iron.

Just here, though, is another point to which I desire to call attention. The advocates of horizontal armor, and also those who have thought but little on the subject, are apt to assign to such armor the quality of invulnerability, when actual practice shows that such is by no means the case. I will inform those who talk of iron decks that 4 in. iron is a positive nuisance in these days of high-powered guns. True it is that the projectile will not bite, but it will smash and curl iron like shavings under a plane. Compound thin plates fare but little better, and with all respect for Sir Joseph Whitworth, I don't think that his system of steel shingles is much of an improvement.

Large steel plates come the nearest to perfection, and they fall far short. The high-powered 10-inch projectile breaks these plates at 7°, as proved at Shoeburyness, and at Gavre it has been proved that shell with quick-acting percussion fuses will not only break the armor, but the pieces of shell will penetrate. Invulnerability has not yet been attained, nor will it be for some time to come. I merely wish to express my conviction now, that a moderately hard steel 3-inch deck plating (say steel of 50,000 lbs. with 30 per cent. elongation) will make of the proposed ram a hard customer to disable with the average high-power gun. I should like to hear from Mr. Roelker with regard to the enormous increase of skin friction due to the water covering partially the turtle-back when the ram is submerged to her fighting lines. He has worked on this question, and I am of an opinion that a light vertical free-board would be an improvement to the ram.

P. A. Eng'r C. R. Roelker.—I have made some calculations to determine the probable engine-power required to propel Admiral Ammen's ram, and I find that at a speed of 13 knots, the present hull at its deepest draught, *i. e.* when its greatest beam is two feet below the water line, would require about 270 horse-powers more than a hull having at the same displacement as the present hull, at deep draught, a cross-section similar to that of the present hull below the plane of its greatest beam. This excess of engine power represents a corresponding increase of weight of machinery and fuel to be carried, and the question is whether it would not be better to raise the hull slightly and modify its form so as to do away with the acute angle of the sponson. The saving in

weight of machinery and fuel thereby effected would enable the vessel to carry additional protective armor at the water-line. Such a modification would probably be of decided advantage if it should be considered desirable to increase the speed of the ram.

It appears to me that a maximum speed of 13 knots is very low for a ram, and I should not give her less than 15 knots on any account. This increased speed would not only enable her to strike a more powerful blow in attacking a vessel in motion, but it would increase greatly her turning power and handiness.

Mr. Gibbons.—It is believed that a speed of 13 knots is all that would be required, the rams not being cruisers, but designed to attack enemies' vessels when entering harbors, and as these last would, from the nature of surrounding circumstances, necessarily move slowly, under such circumstances it was not probable that more speed would be needed.

There would be no great trouble in providing a higher speed, the model being such that this could readily be had.

At time of delivering a blow a higher speed than 8 knots was believed not only to be unnecessary but even dangerous.

P. A. Eng'r G. W. Baird.—I observe that all of the photographs exhibited here to-night are of impressions or holes made by projectiles fired at the steel targets at right angles to their surfaces. During the war of the rebellion I served in vessels on the western rivers, where I saw soft iron plates, one inch thick, at an angle of about 45 degrees, turn 32 pound shots hour after hour; and from this experience I feel convinced that at the angle Mr. Gibbons has arranged his deck, it would be impossible to penetrate it with any projectile whatsoever, no matter whether he uses steel or iron of the thickness shown upon his plans.

About nine years ago I did some work for Admiral Ammen on plans for his ram, and find that the amount of boiler proposed by myself is very nearly the same as called for in Mr. Gibbons' design, but I provided an immense steam-drum or reservoir, from which the engines were to take steam, which would permit the throttle to be opened suddenly without fear of making the boilers foam, and I think Mr. Gibbons will find, in practice, that this will be essential. The type of boiler that I designed was the cylindrical return tubular, in common use on board sea-going ships carrying high pressures, and the engine I proposed using is one that was built in 1866 for the *Epervier* (which vessel was never completed); it is a steel engine of two 36-inch cylinders with four feet stroke of pistons.*

Mr. Gibbons.—The boilers proposed to be used are the common types of cylindrical boilers, with furnaces in the ends of the flues, and two furnaces at each end; these boilers had not proved in experience to be liable to foam or that they were given to foaming; there was room for sufficient steam space to supply the demands of the cylinders without danger of carrying over the

* The engine was exhibited at the Centennial Exhibition in 1876 and excited much admiration, and, in my opinion, it is the handsomest designed engine ever produced by the Bureau of Steam Engineering.

water, even when throttle valves were wide open and cut-off set at eight-tenths stroke.

P. A. ENG'R G. W. BAIRD.—While serving on board the Trenton a few years ago I made a comparison between the energy exerted by the vessel running at full speed with that of the concentrated fire of the battery of eight inch rifles, and found a surprising as well as curious result. Steaming at 14 knots, and striking another vessel at rest, the energy would be $\frac{WV^2}{2g} = 25{,}868$ foot tons, or sufficient to raise the whole weight, vertically, a little over six and a half feet, and the concentrated fire of 10, out of the 11 guns, with the projectiles having a striking velocity of 1450 feet per second, would be almost exactly the same. I do not believe any structure made by human hands could withstand such a blow.

ADMIRAL AMMEN.—At a former discussion of this proposed construction I was gratified to observe the very general commendation accorded; I then stated the many obligations I am under in this work to many of my brother officers, and to none more than to our late distinguished naval constructor, John Lenthall, whose death is deplored by all who knew him.

In looking at the drawings and regarding the apparent simplicity of the construction, it would hardly be supposed that this work extended over a period of years. Doubtless the construction of one or more vessels on this design will suggest modifications of value. In this connection I may say that were one ram built with twin screws, and another with the Mallory propeller, both on the same lines, with the same boiler power, and engines suitable to both modes of propulsion, I think much more would be gained through a fair comparison than the whole cost of the inferior vessel, whether she proves the one or the other.

To one point I wish to call attention; this vessel can be armor-plated, not as an incumbrance and a disadvantage, as is the case with ordinary vessels, but with a positive advantage for the purposes intended, other than protection. The distribution of weight as required in the armor-plating would add greatly to the longitudinal strength, and with the angles at which shot and shell would strike the hull, the thickness of armor-plating need not be extraordinary to give entire immunity from projectiles.

I think that a sufficient examination of the construction of the vessel will support the fact that were she to strike a solid body when moving with a high velocity, whilst everything not sufficiently bolted and braced internally would fly, the hull would remain practically intact. As for anything that floats, the "Inflexible," for example, I suppose she would run into her as though she were a pumpkin, and that the few seconds' time element, during which the ram would be brought to a stand-still, would be quite sufficient to prevent any serious internal disarrangement from the concussion.

Since Mr. Gibbons asked an examination of what I proposed, it occurred to me that the engine-room and machinery could be surrounded by an air-tight bulkhead, and an air-lock and an air-pump provided, and an air pressure of about 7 pounds (slightly in excess of the water pressure of her draught) main-

tained in the body of the vessel, with gauges of pressure in the various compartments put up in the fire-room. Should a torpedo be exploded under any part of the body in which the air pressure was maintained, unless the force was sufficient to disrupt the upper works, there would be a slight escape of air through the pressure until an equilibrium of internal and external pressure resulted. Air escape would at once be shown by the gauge, and repairs could be effected by the use of thrummed mats, planks, stanchions, wedges and mauls, under such conditions as would be utterly impossible unless the vessel was supported by air pressure.

Every nation has its peculiar necessities for defence, and in order that this should be achieved with the greatest economy, surrounding conditions should be closely considered.

A full consideration, too, requires that the army and the navy should be regarded as complements and factors, and that the one or the other should, for the purpose in view, be considered the principal or the only factor. This is notably the case in any possible war with Great Britain or with Spain.

But in case of war with any powerful nation we should have the means afloat to repel from our sounds, bays and immediate vicinity of our harbors whatever hostile fleet should present itself, and without intending to try to outline all that our navy should do, it seems to me that we can with great advantage construct rams and see how far we may feel willing to rely on them. Whatever confidence we may feel in any proposed means of warfare, it only becomes a reality when put in a palpable form. If the Marine Ram will not fulfil all the expectations that a very large number of our officers entertain as to its capabilities, the sooner we become aware of its defects the better. On the other hand, if we find it all that we anticipate, the sooner we have the advantages of a practical development through construction, the sooner we will be prepared to meet any contingency that may be forced upon us ; which is far more likely to occur while we lack preparation than after we are well provided with a powerful means of defence.

I beg to express my indebtedness to Mr. Roelker for his suggestions at various times, and specially for calculations as to possible attainable speed of the ram. I think it likely that in order to lessen resistance that the width of the sponsoning may be increased somewhat, so as to give satisfactory lines of deflection, and the greatest beam could then be carried little below the water line, and thus lessen the resistance. We should, I think, build rams, and in this connection I would say that a comparison of the merits of twin screws and the Mallory propeller, on identical hulls, would be of far more value than the cost of the ram which may prove the inferior. The building, too, of such vessels will doubtless suggest improvements which cannot be arrived at in any other manner than through construction.

I trust that all of the gentlemen present feel indebted to Mr. Gibbons for his interesting paper upon what is known as the Ammen Marine Ram. It is proper to state, as I have on other occasions, that in the details of construction generally I am very much indebted to my brother officers, and particularly to our late Chief Naval Constructor Lenthall, whose ability and character we so highly appreciate and whose memory we cherish.

NAVAL INSTITUTE, WASHINGTON BRANCH.

MAY 25, 1882.

REAR ADMIRAL C. R. P. RODGERS, U. S. N., in the Chair.

THE GULF STREAM.

NEW DATA FROM THE INVESTIGATIONS OF THE U. S. COAST AND GEODETIC SURVEY STEAMER "BLAKE."

BY COMMANDER JOHN R. BARTLETT, U. S. N.

My paper, read before the Institute last winter, was so kindly received, that it is with pleasure I now give the results of the Blake's summer cruise in the Gulf Stream. My previous paper told of the source of the Gulf Stream, beginning with the equatorial current at Barbadoes, and following it in its course through the Gulf of Mexico to the Straits of Florida. Our work was over entirely new and unexplored ground, and I was not hampered with theories, nor had there been anything written on the subject.

The Gulf Stream, that body of warm water flowing through the Straits of Florida and along our coast, which is said by many to influence the climate of England and northern Europe, is a subject on which much has been written, each writer solving the question in a manner satisfactory to himself. I shall therefore treat the main subject with hesitation, merely giving my deductions from the actual facts obtained by the Blake's party, and, if not throwing much new light on the subject, I will endeavor at least to correct a few popular errors.

A President of the Royal Geographical Society once said to that body:

"The Gulf Stream was almost as great a nuisance as Macaulay's New Zealander, or the German who evolves things from the depths of his consciousness. There are certain remarks which nobody ever

makes without a certain air of superior wisdom, and the man who affected familiarity with the Gulf Stream always seemed to feel himself six inches taller in consequence. I should have real pleasure in learning that the Gulf Stream had been definitely exploded."

After three months' continually crossing and recrossing the Gulf Stream from Jupiter Inlet, Florida, to Cape Hatteras, and with the many facts that I have obtained, I do not as yet affect familiarity with this great wonder of the ocean, and so cannot claim the additional six inches. I will lay the facts before you, however, and in the near future hope to contribute such additional information as will make all familiar with the Gulf Stream.

The Blake reached Cape Canaveral, May 22, 1881. My instructions from Mr. Patterson, then Superintendent of the Coast Survey, were to run lines normal to the coast every sixty miles, beginning at Jupiter Inlet, Florida, and extending to Currituck, N. C. On these lines I was directed to take soundings at distances of five miles, with surface and bottom temperatures; also frequent series of temperatures at various depths. The temperature of the water from the surface to thirty fathoms was especially required to determine the bifurcation of the Stream into warm and cold bands, as had previously been reported.

Every fact possible was to be obtained in regard to the boundaries and circulation of the Stream, and every line was to be completed before beginning another.

I found it more practicable to do only one class of work at a time, and, with the approval of the Superintendent, confined my labors to soundings, with bottom and surface temperatures—the serials to be carried on at another time.

I will give some account of the first line, although all the lines explain themselves in a study of the cross sections as represented, and the data obtained on each line. On May 29th we anchored a few hundred yards from Memory Rock, Little Bahama Bank, in four fathoms of water. Memory Rock is a mass of coral about one hundred feet long by fifty wide, and its highest part is fifteen feet above the water. On May 30th a line of soundings was run across the Stream to Florida. To run the distance, forty-eight miles, from the rock to Jupiter Inlet light, with the time necessary for soundings at every five miles, required nine hours. Three miles per hour were allowed as an *average* current, and a course was steered for a point twenty-seven miles south of Jupiter Inlet; that inlet being almost due

west from our starting point. Running by patent log 6.1 miles between soundings would bring them five miles apart on the true line. We left Memory Rock so as to bring the noon position as near the centre of the Stream as possible. The shore was made about two miles to the southward of Jupiter Inlet; the sea being smooth, with a light SE breeze. To our noon position we had a northerly current of from 1.5 to 2.7 miles per hour; from the noon position to sighting the light, the current was over five miles per hour, and thence three, two and one mile, until we anchored. We were exactly nine hours in running the line. In addition to the soundings every five miles with surface and bottom temperatures, other temperatures were taken at short intervals to a depth of thirty fathoms. Again we crossed to the Bahamas and returned to Florida, these latter lines being principally for observations of temperatures. We found the same average current, but the strength in the axis was near the east or west shore, according to the direction of the wind. The temperatures below the surface were taken with the Miller-Casella thermometer. The electric apparatus, which had been placed on board before sailing, could not be used at this time, owing to the non-arrival of an ice machine which had been ordered from France.

The first line, called A, was the only one where serial temperatures were taken. The soundings across the Florida channel, from Memory Rock, with surface and bottom temperatures, were as follows:

At anchorage near Memory Rock, in four fathoms water. Surface 78°; Bottom, 78°.

5 miles.	Surface,	81½°	294 fth.	56½°
4½	"	81½°	347	52°
4½	"	81½°	395	45°
4½	"	82½°	439	44°
5½	"	83°	416	44°
5	"	83°	341	44°
5¾	"	82½°	250	50°
5	"	80°	176	50°
5¼	"	80°	95	57°
2¼	"	80°	31	71°
2¾	"	80°	10	78°

2¼ miles from shore.

The area of this cross section is 429,536,240 square feet, and assuming the velocity at three knots, the delivery per hour would be 51,028,905,312,000 gallons.

The lines of soundings were continued to Currituck, N. C.; on two occasions we crossed previous lines and obtained exactly the same depth, to a fathom.

The work of the season gives very interesting data in regard to the physical features of the bottom of the ocean over which the Gulf Stream flows. Instead of a deep channel in the course of the Stream, as reported by Lieutenants Maffit and Craven, and published in the Coast Survey Reports, our later soundings show an extensive and nearly level plateau, extending from a point to the eastward of the Little Bahama Banks to Cape Hatteras—off Cape Canaveral nearly 200 miles wide, and gradually contracting in width to the northward, until reaching Hatteras, where the depth is more than 1000 fathoms within thirty miles of shore. This plateau has a general depth of 400 fathoms, suddenly dropping off on its eastern edge to over 2000 fathoms. The soundings in the strength of the current were all taken with the 60-pound shot sinkers, each being detached on reaching bottom. The time allowed for the sinker to reach the bottom was less than one minute to each one hundred fathoms in depth. Most of the soundings on each side of the Stream were taken with a 36-pound lead on the sounding wire, the lead being reeled back each time. Specimens of the bottom were obtained at nearly every sounding; the only failure was in using the lead with the Stellwagen cup, in which case, while waiting for the bottom thermometer to register, the specimen was washed out by the motion of the vessel. Enough specimens were obtained, however, to give a very good idea of the bottom where the lines were run. The course of the Gulf Stream can be traced by a study of these specimens. On each side of the Stream the cylinder brought up ooze, but in the strength of the current the bottom was washed nearly bare, the specimens consisting of small pieces of disintegrated coral rock. This bare portion was very hard, and the sharp edge of the brass cylinder came up indented and defaced. From Jupiter Inlet, with the exception of the bare part mentioned, the specimens were a light-colored ooze, composed of pteropod shells with a mixture of coral sand. Off Charleston, where the plateau has less depth than to the southward, the bare section extended the whole width of the Stream. The pteropod ooze extended only to Charleston; to the northward of that, the bottom specimens contained a great many globigerina. To the northward of Cape Lookout and off Hatteras, the bottom was globigerina ooze of a dark greenish color.

In the Caribbean Sea and Gulf of Mexico the bottom is always pteropod ooze. These pteropods are brought along by the Gulf Stream. Sir C. Wyville Thomson reported most of the North Atlantic bed to be globigerina ooze, and as far as off the George's Banks the Blake always found the same. The fact of finding the globigerina ooze off Hatteras, with its gradual diminution, and at last its total absence to the southward, would tend to show the limit of the Arctic current. The globigerina were not found anywhere on the plateau to the southward of Charleston.

The Gulf Stream has for its western bank the 100-fathom curve as far as Cape Hatteras. It has a depth of 400 fathoms as far as Charleston, where it is reduced to 300 fathoms; but the Arctic current has for its western bank the 1000-fathom curve, which is quite close to shoal water from the George's Banks to Hatteras.

The specimens of the bottom seem to me to throw very important light on the circulation, for from them alone we can state as a fact that the Arctic current does not extend below Hatteras along our coast; but at this point the Arctic current, with its colder and heavier waters in following its banks, the 1000-fathom curve, meets the Gulf Stream, under which it passes and follows around outside of the plateau towards the equator. In addition, the temperatures that were obtained at the bottom confirm the same fact. Many have met icebergs advancing against the Gulf Stream, carried along by the lower part of their immersed section, which is in an opposite current coming from the northward. A branch of the Arctic current, which brings these icebergs south, tends to the westward after rounding Newfoundland, and flows along our coast as far as Hatteras.

My instructions laid particular stress on the temperatures of the surface and to five fathoms below, in order to show the bifurcation of the Gulf Stream into warm and cold bands. The temperature of the surface water was taken at *every mile* on all lines. The water for this purpose was drawn over the stern. At every sounding the temperature of the surface was also taken forward and compared with that aft. Both thermometers were compared with a standard each day. I was furnished with a diagram, published in 1861, to accompany the Coast Survey Report, as a guide to me as to what I was expected to find. The surface temperatures obtained by the Blake do not show any bifurcation of the Gulf Stream before reaching Hatteras. At this latter point I only ran out a few miles, but even then there were indications of warm and cold bands. To the south-

ward of Hatteras, or rather Cape Lookout, the Stream was not marked by a change in the color of the water as to the northward.

The surface temperatures found in the Stream are much below those generally given by writers; probably mine would agree with those really found, as most of the writers were never there themselves. The average temperature in the axis of the Stream rarely exceeded 83° F. in June and July. On one or two occasions the thermometer read as high as 86°, and once 89°; but it was at high noon in a dead calm. The temperature at five fathoms did not range above the average of 81½°.

The increase of temperature of the surface was found as we entered the current, and the curve was over the higher temperature found at the bottom.

The surface temperatures did not indicate a cold wall inside of the Stream, and the water inside of the 100-fathom line to the shore seemed to be an overflow of the Stream, as the temperatures to five, ten, and fifteen fathoms were nearly as high as those found in the Stream.

The temperatures at the bottom in the Stream, at corresponding depths, were the same as those found in the Windward passage and in the course of the current to the Yucatan passage. The average bottom temperature at 400 fathoms was 45°, and, as off Charleston, in 300 fathoms, 53°. The temperature at 300 fathoms, off the George's Banks, was found in July to be 40°, and this latter was the temperature that we found at the same depth just north of Hatteras and the Gulf Stream.

I have stated that the surface temperatures did not show a cold wall inside the Stream, but the bottom temperatures give a narrow cold section close to the 100-fathom curve all along the course of the Stream from Hatteras to Florida. Soon after leaving the Straits of Florida there is a division of the Stream shown by the bottom temperatures, part following the coast and the remainder branching off to the eastward.

Temperatures at varying depths are now needed to facilitate the study of the Stream. The results of the last work of the Blake may be considered as little more than giving the contour lines. In the dredgings made by the Blake we have brought the tropical fauna as far north as Hatteras; but off the Chesapeake, Delaware, and Narragansett bays the specimens were strictly Arctic in their forms of life. I have no doubt in my own mind that the Gulf Stream causes the

mild climate of England and the Scandinavian peninsula, and keeps the port of Hammerfest, in Norway, open all the year round. I trust that our government will continue the present investigations until it can be proved. Prof. Dahl, of the Coast Survey, reports that the current at Behrings Strait flows south, or out of the Arctic Ocean. Is not this the Gulf Stream after a journey around Europe and Asia?

But I am wandering from my sounding ground, and must say something of the strength of the currents. I can only give you an account of those found by the difference between course and distance run and the observations. The directions and velocities are of course only for the time we were actually at a particular part of the Stream, and under the existing circumstances of direction and force of the wind. We found that three knots was a general average to allow for the whole Stream; this would give a greater velocity at some central point. Between the Bahamas and Florida the average was exactly three miles per hour, but for a distance of fifteen miles in the axis of the Stream it was as high as 5.4 miles per hour. To the northward of the Bahama Banks, and to the eastward of the Stream, there was a slight current setting SE. We found the direction of the current in the Stream very much affected by the wind, sometimes inclining it to the east, then to the west. In the latter part of June, 1881, we were hove to some fifty miles east of the Gulf Stream, off Charleston, when we experienced a current of three miles per hour, setting SE; wind blowing a gale from SW.

The sudden rise of the plateau off Charleston, together, probably, with the meeting of the Arctic and warm currents, creates a remarkable disturbance at this point. In July, 1880, I reported finding a current off Charleston, some fifteen miles or more from the 100-fathom curve, setting SW. When our trawl was dragging on the bottom, the vessel headed NE, and drifted over two miles an hour SW. I found this SW current off Charleston, and between Charleston and Cape Fear, every time last summer that I crossed the Stream, but I did not find it at any other point. In the summer of 1880 we passed through a wide belt of rippling water off Charleston, and this last summer I was frequently asked by captains and pilots if, in my cruising in the Stream, I had seen "Little Hell," off Charleston. We crossed the Stream six times in this locality under conditions of weather from a calm to a strong breeze, and always crossed, near the centre of the Stream, bands of rippling water several miles in width. It is very like the rip at the entrance to Long Island Sound.

A very striking example of the influence of the wind on the current was experienced off Cape Lookout. We were in mid stream with the current setting well to the northward, when a fresh gale came on from NW; the current was turned almost due east, and for twelve and a half hours we had a current of 4.9 miles per hour E by N. The vessel was heading west all this time under full steam and reefed foresail.

At such points as we anchored off the coast, in from twenty to sixty fathoms, the current cans gave a set to the northward of about .7 mile. Near the coast the set of the current depends entirely on the direction of the wind.

We had, as a whole, very good working weather, and, what was especially necessary, a clear sky; although twilights, on which we principally relied, were very difficult to obtain, owing to the mist which arose from the heated water of the Stream. We had a few very heavy squalls off Hatteras, and one gale of wind that lasted four days, during which I took a sounding, while hove-to under close reefed mainsail and steam, in 2480 fathoms, without any trouble whatever, which speaks well for the Sigsbee sounding machine. Commander Sigsbee, in his book on deep-sea soundings, has given an exhaustive description of all the appliances used on the Blake to date, but, as the Siemens deep-sea thermometer is entirely new, it will interest you to have some account of it. Its principle is based upon the variations in resistance of metals to the passage of an electric current arising from changes of temperature. We have 2600 fathoms of double insulated cable wound on the dredging reel; to the end of this is attached a resistance coil, which coil can be lowered to any depth desired.

The other ends of the insulated cable are brought to a room on the main deck, and are attached to a Wheatstone bridge especially arranged for this purpose. Another resistance coil of the same material and resistance as that lowered into the sea, is likewise attached to the bridge. This latter coil has an attached thermometer, and is kept in a copper vessel filled with water. A battery of twelve Leceanche's cells and a Thomson's marine galvanometer are attached to the bridge. If the resistance coil at the end of the cable is lowered into the sea just below the surface, and water from the same place is placed in the copper vessel containing the comparison coil, a current being sent into the bridge, the reflected pencil of light will be at zero on the scale, as under these conditions both resistance coils are in the same temperature.

If the cable is then paid out and the resistance coil at its end reaches any depth, say one hundred fathoms, where the temperature is lower, the circuit being closed, the pencil of light will be deflected to the left. Now, if cold water is added to that in the copper vessel containing the comparison coil, with the circuit closed, until the pencil of light comes back to zero on the scale, it is assumed that the temperature of the water around each coil is the same, and the reading of the attached thermometer of the comparison coil will give the temperature at one hundred fathoms, the depth to which the cable was lowered.

After taking a series of temperatures to 800 fathoms in this way, the cable was reeled in, stopping at intervals for temperatures; in this case with circuit closed, the deflection of light was to the *right*, and it was necessary to raise the temperature in the copper vessel until the light was brought to zero on the scale.

After August 10th, fearing the approach of the hurricane season, sounding work was suspended, but before returning north I made a number of trials with the Siemens apparatus. I received a Carré ice machine at Fortress Monroe, and used the ice water made by it to reduce the temperature of the deck or comparison coil. The trials were made in latitude 37° N, longitude 74° 30′ W, about 100 miles east of the Chesapeake, during a perfect calm with smooth sea. The ship's engine was not used during the time. Under the above conditions the results of the several lowerings were very satisfactory indeed. Having taken many thousand deep-sea temperatures with the Miller-Casella thermometers, my confidence in them was greatly strengthened when, after repeated lowerings, I found the two methods to agree. With the Siemens apparatus, readings can be taken to one-quarter of a degree, with the Miller-Casella it is hard work to decide on a half degree. I give an example of a single lowering:

Depth in fathoms.	Surf.	5	10	15	20	30	50	75	100	150	200	300	400
Siemens apparatus.	76½°	76½	76½	69	58	54	54¼	52½	50½	46½	43½	40½	40
Miller-Casella.	76½°	76½	76	68	58	54	54	52½	50½	46½	43½	40½	40

The above was taken on August 11th; on the 12th, the Siemens thermometer indicated a warm strata of water between thirty and seventy-five fathoms; the Miller-Casella gave only the maximum and minimum, and did not indicate this. The temperature at twenty fathoms was 57° with both thermometers, at thirty 52°; but at fifty

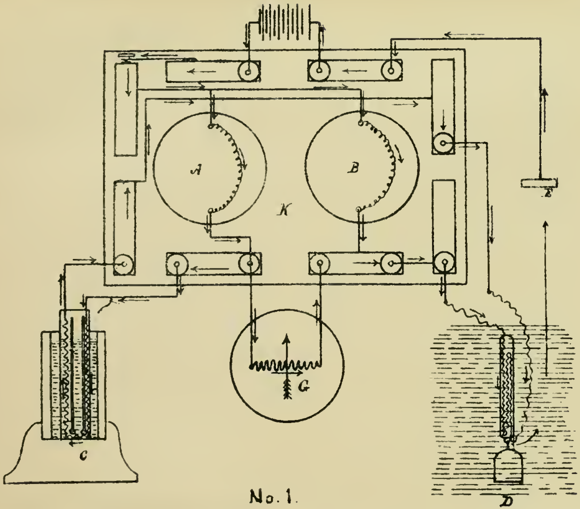
fathoms the Siemens thermometer read 54½°, while the minimum of the Miller-Casella read the same as at thirty fathoms; at seventy-five fathoms the Siemens read 53°, the Miller-Casella still 52°; at 100 fathoms they agreed at 50½°. These observations were continued during the entire day, with always the same results.

By lowering the Miller-Casella thermometer at the rate of 200 fathoms per minute to fifty fathoms, and hauling it by thirty fathoms at the same rate of speed, the temperature would read as high as 53½°. It is certainly very important to be able to detect underlying currents, and with this new apparatus we shall obtain many new facts. It is a practical and very simple means of overcoming the trouble of obtaining accurate deep-sea temperatures, and great credit is due to Mr. Siemens, of London, for its invention, and to our Coast Survey for being willing to expend the large amount for necessary apparatus for its trial.

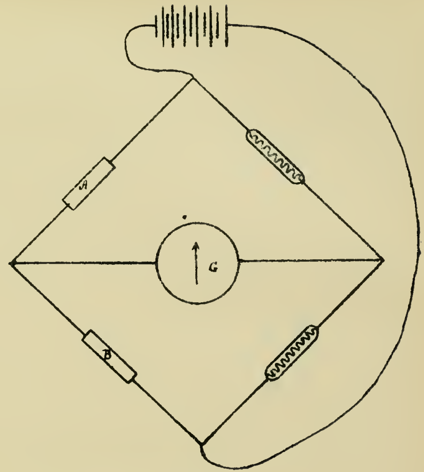
While off Charleston, in the full strength of the Gulf Stream, I made several lowerings during moderate weather, with the vessel rolling 15°; it was very difficult to read the galvanometer, and it could only be done with the ship's engine at rest. Even under these trying circumstances the temperatures agreed.

I trust that you will pardon me if I make a slight digression to state a fact in physics, of which many of you may be familiar. I am often asked what is the lowest temperature I have found when sounding. My reply has been: 35° F. in 3000 fathoms. I am generally told that this is impossible, as the temperature of the maximum density of water is 39½°, and that if my thermometers show a lower temperature it must be owing entirely to pressure. If physics did not teach them differently, a single illustration from the Blake's soundings would prove that they are in error. In the Windward passage we found the temperature at 700 to be 39½°, and the same to the northward and southward of the passage at the same depth. North of the connecting ridge between Cuba and Hayti the temperature gradually fell as the depth increased, until at the bottom in 2000 fathoms it was 36½°; but south of the ridge, and within twenty miles, the temperature was 39½° at 2000 fathoms. The pressure was the same in both cases.

Ganot says: "Water presents the remarkable phenomenon that when its temperature sinks it contracts up to (4° C.) 39½° F.; but from that point, although the cooling continues, it expands up to the freezing point, so that 39½° F. represents the point of greatest contraction of water."



No. 1.



No. 2

The above is very often quoted to me; but I find that Ganot states, if water contains salts or other foreign bodies its freezing point is lowered, and that sea water freezes at (— 2.5° to — 3° C.) about 27° to 26½° Fahr.

In 1833, M. Depretz determined that the temperature of the maximum density of sea water, which contracts steadily till just above its freezing point, is —3.67° C., or 25.4° F. Sir C. Wyville Thomson found the average temperature of the bottom of the deep sea in temperate and tropical regions about 0° C. or 32° F. In 1818, Sir John Ross, during his Arctic voyage, found a temperature of —3.5° C. (25.75° F.) in 680 fathoms, and Thomson found as low as —3° C. off Greenland. With the Siemens apparatus I found 38½° at 800 fathoms; the Miller-Casella giving the same reading.

The Coast and Geodetic Survey will continue these interesting investigations of the Gulf Stream, and while I am connected with that service, it will always give me pleasure to present to you the results of the work done by the party under my command.

Prof. Hilgard, the present Superintendent, kindly gave me permission to use the data that I have given you in this paper.

Siemens Electrical Deep-Sea Thermometer.

No. 1. Represents the whole apparatus.

No. 2. Represents the principle of the Wheatstone bridge.

A, *B*—Resistance coils equal to the resistance of the wire contained in the cable and the comparison coils.

C—Copper vessel containing deck resistance coil with attached thermometers.

D—Deep-sea resistance coil.

E—Earth connection, consisting of copper wire placed in the sea over the side of the ship.

G—Galvanometer.

LINES OF SOUNDINGS, WITH GENERAL DATA, RUN NORMAL TO THE COAST AND ACROSS THE GULF STREAM, FROM JUPITER INLET, FLA., TO CURRITUCK, N. C., BY THE COAST AND GEODETIC SURVEY STR. "BLAKE," COMMANDER J. R. BARTLETT, U. S. N.

LINE A. FROM JUPITER INLET, FLA., TO MEMORY ROCK, LITTLE BAHAMA BANKS.

2¼ Fne S	2½ G. Sh. 80° N.	2¾ 95 .... 80° 57° N. 2	5½ 270 Co. S 80° 50° N. 3	5 265 Co. S. 82½° 50° N. 5.4	5¾ 341 Co. S. 83° 44° N. 5.4	5 416 Co. S. 83½° 44° N. 5.4	5½ 439 Ptd. oz. 81½° 44° N. 2.7	4¾ 395 Co. S 81½° 45° N. 1.25	4½ 347 Co. 81½° 52° N. 1.25	4¾ 204 Co. 81½° 56½° N. 1.25	4¾ 67 Co. 80°	½ 4 Co. 78° 78° Var.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....

LINE B. FROM SHORE, LATITUDE 27° 57′ N. TO LAT. 27° 51′, LONG. 77° 33′ W.

10	13 54 gn. S. 80° 57° N. 2	4¾ 158 Fne. S 80° 52° N. 2	5 231 Fne S 80½° 46½° N. 2¼	5 321 Co. S. 81° 44½° N. 2¼	4½ 446 Co. 81° 42½° N.N.W. 3.5	4 426 Co 81½° 44½° N.N.W. 4	3⅛ 387 Co 81½° 46½° N.N.W. 4	4⅝ 394 Co. 82° 47½° N. 3	5¾ 412 Co. 82° 46° N. 2	5⅛ 448 Co. S. 82° 45° N. 1.5	5¾ 460 Co. S. 82° 44° o	6 497 Co. S 81° 44° S. 0.5	4¾ 473 Ptd. oz. 79° 44½°	4¾ 483 Ptd. oz. 79° 44½°	4⅝ 504 Ptd. oz 79° 44°	5 516 Ptd. oz 78° 44°	5¼ 537 Ptd. oz. 78° 43¼°	4⅜ 563 Ptd. oz. 78° 42½°	5 582 Ptd. oz. 78° 40°	4½ 589 Ptd. oz. 78° 39¾	5¼ 584 Ptd. oz. 79° 39½°	5⅛ 589 Ptd. oz. 78° 39½°	5¾ 6[illegible] Ptd. oz. 78° 39°	8 609 Ptd. oz. 78° 39°	5 619 Ptd. oz. 77½° 39°	5¼ 621 Ptd. oz. 78° 39°	....	....

(.................................Southerly.................................)

LINE C. FROM SHORE, LATITUDE 28° 40′ N. TO LAT.* 28° 44′ N., LONG. 78° 22′ W.

5 25	15¾ 77 .... 80° 50° N.×E. 2.5	4½ 173 Co. S. 80° 49° N.×E. 2.5	4½ 265 Co. S. 80° 44½° N.×E. 2.5	4½ 425 Co. S. 81° 42½° N.×E. 2.5	4½ 464 Co. 81° 42½° N.×E. 2.5	4¾ 459 Co. S. 81½° 43½° N.×E. 3	4⅗ 465 Ptd. oz 81½° 44° N.×E. 3	4⅝ 466 Ptd. oz. 81¾° 44° N.×E. 3	4⅝ 459 Ptd. oz 81¾° 44° N.×E. 2.8	4⅝ 456 Ptd. oz. 82° 45° N. 1.5	3⅝ 458 Ptd. oz. 82° 45° N. 1	3⅞ 466 Ptd oz. 81½° 45° o	5⅝ 464 Ptd. oz. 80° 45° o	10 478 Ptd. oz. 79° 44½° S.×E. .8	10¼ 494 Ptd. oz. 79° 43½° S.×W. 1	9¼ 513* Ptd. oz. 78½ 42° S.S.W. 1.5	9¼ 528 Ptd. oz. 79° 41°	....	....	....	....	....	....	....	....	....	....	....

LINE D. FROM SHORE, LATITUDE 29° 25′ N. TO LAT. 29° 32′ N., LONG. 76° 38′ W.

9¼ 25 Brk. Sh 80° 70°	8¾ 27 Brk Sh. 82° 64½° N.W. 1	4⅞ 42 Crs. S., brk. Sh 82° 55½° N.W. 1.5	4½ 225 Crs S., brk. Sh. 83° 43° N.W. 1.5	4 284 Fne S. 85° 44½° N.×W. 2	4½ 344 Co. S. 88¾° 43° N.N.W. 3	3⅛ 387 Co. 88¾° 44½° N.N.W. 3	3¾ 415 Co. 86¾° 45¾° N.N.W. 3	5 433 Co 85½° 45¾° N.N.W. 3	4¾ 457 Co 84° 46° N.N.W. 3	4¾ 449 Co 84° 45° N.N.W. 3	5½ 445 Co 84° 46° N.N.W. 3	5½ 444 Co. 84° 48°	5⅝ 451 Co. 83° 47°	9¼ 441 Ptd. oz. 81½° 47½°	9 448 Ptd. oz 83½° 47½°	9 459 Ptd oz. 80¾° 47¼°	9 467 Ptd oz 80½° 43½°	10 470 Ptd. oz. 80½° 45°	10 467 Ptd. oz. 81° 43½° o	10⅜ 468 Ptd. oz. 81° 46° o	10¼ 476 Ptd. oz. 81° 47° o	9⅞ 4[illegible]8 Ptd. oz. 81½° 46¾° o	9¼ 523 Ptd. oz. 84° 45° o	9 510 Ptd. oz. 82° 47½° o	9⅛ 559 Ptd. oz. 81½° 44½° o	9¾ 604 Ptd. oz. 81½° 37½° o	9½ 2100 Ptd. oz. 81½° 36½° o

(.................................Slight current to Southward.................................)

LINE E. FROM ST. JOHN'S RIVER, FLA., TO LAT. 30° 30′ N., LONG. 76° 44′ W.

22½ 25 .... 82° 68°	2¾ 47 .... 82° 66½° N.N.E. 2.7	5⅓ 141 .... 83° 47° N.N.E. 2.7	4⅓ 195 Co. bk. S. 83½° 46½° N.N.E. 2.7	4¼ 271 Co. 83¾ 43° N.N.E. 2.7	4⅜ 314 Co. S. 83½° 44° N.N.E. 2.7	4 375 Co. S. 83° 44° N.N.E. 2.7	4⅛ 444 Co. S. 83° 44° N.N.E. 2.7	4⅛ 460 Co 83° 44° N.N.E. 2.7	4 480 Co 82½° 44° N.N.E. 2.7	5¼ 480 Co 82½° 45° N.¾E. 1.25	5¾ 467 Co. S. 82½° 45½° N.¾E. 1.25	5¼ 445 Co. S. 82½° 47° N.¾E. 1.25	5 449 Co 82° 46½° N.¾E. 1.25	5⅛ 464 Ptd. oz 82½° 46° N.¾E. 1.25	4¼ 456 Ptd oz. 83° 45½° N.¾E. 1.25	6¼ 453 Ptd. oz. 83° 44½° N.N.E. 1	10¼ 456 Ptd. oz. 82½° 44° o	10¾ 475 Ptd oz 84½° 45° o	11¼ 482 Ptd. oz. 83° 47° o	11 466 Ptd oz. 83½° 46° o	11¾ 464 Ptd. oz. 85¾° 46° o	10¾ 4[illegible]4 Ptd. oz. [illegible]4° 45½° o	10⅞ 585 Ptd. oz. 82° 39½° o	9⅛ 1047 Ptd oz. 81½° 38° o	10⅞ 1531 Ptd. oz. 80¾° .... o	10⅞ 1638 Ptd. oz. 80¾° 36¾° o	....

LINE F. FROM TYBEE ROADS, GA., TO LAT. 30° 51′ N., LONG. 77° 09′ W.

8½ 21 G. .... 70½° o	8⅜ 20 G .... 67° N.N.E. 1	5⅝ 31 S. brk. Sh. 80½° 67° N.N.E. 1	5⅞ 53 Bk., wh., G. 81½° 63½° N.N.E. 1	6 122 .... 81½° 59° N.N.E. 1	6⅛ 266 Co. 82½° 43½° N.N.E. 1	6 265 .... 82° 44½° N.N.E. 2.4	5⅛ 265 Co 82° 46½° N.N.E. 2.4	5⅛ 280 Co 82° 48½° N. 1.5	5⅞ 320 Co. 82° 50° N. 1.5	5¼ 301 Co. 83° 51° N. 1.5	5⅛ 338 Co. 83° 53½° N. 1.5	5¼ 385 Co. 82½° 54½° N. 1.5	5 434 Ptd. oz. 82° 54½° N. 1.5	5⅛ 445 Ptd. oz. 82½° 53° N. 1.5	5 183 Ptd. oz. 81½° 46° N. 1.5	5¼ 474 Ptd. oz. 81½° 46° N. 1.5	5⅛ 474 Ptd. oz. 81½° 45° N. 1.5	23⅛ 505 Ptd. oz. 81° 44½° o	22⅛ 578 Ptd. oz. 81° 39½° o	7⅛ 981 Ptd oz. 82° 38° o	....	....	....	....	....	....	....

LINE G. FROM CAPE ROMAN, S. C., TO LAT. 30° 59′ N., LONG. 77° 17′ W.

6 25	5½ 75	7 142	5½ 225	5⅛ 217	2¾ 216	5 228 .... 80° 45°	7 225 .... 80° 45° E.¾N. 3.2	3½ 284 Co. S. 82° 44° E.¾N. 3.2	3½ 254 .... 82° 45½° E.¾N. 3	3¾ 349 Co R. 82½° 44½° E.¾N. 3.2	3½ 344 Co R 83° 45° E.¾N. 3.2	3¾ 353 Co R. 82° 46½° E.¾N. 3.2	3⅛ 378 Co 82° 48° E.¾N. 3.2	3¾ 312 Co 82° 51½° E.¾N. 3.2	3¾ 316 Co. 82° 53° E.¾N. 3.2	3¾ 310 Co. 83° 52° E.N.E. 2.5	4 325 Co. 83° 53° E.N.E. 2.5	4 353 Co. 82° 54° E.N.E. 2.5	4⅜ 413 Co. S. 82° 51° E.N.E. 2.2	4 438 Co. 81½° 47° E.N.E. 2	6⅞ 458 Ptd. oz 81½° 46° E.N.E. 1	5⅜ 456 Ptd. oz. 81½° 46° N.E.¾E. 1	7⅛ 499 Ptd. oz. 81° 47° N.E.¾E 1	7¼ 528 Ptd. oz. 81° 42½° N.E.¾N. 1.3	10½ 626 Ptd. oz. 81° 39° N.E.¾N. 1.3	....	....

LINE H. FROM SHORE, LATITUDE 33° 38′ N. TO LAT. 31° 27′ N., LONG. 76° 00′ W.

20¾ 29 Crs. gy. S. bk. sp 80° 73° N.E. 0.4	7 32 G. sh. 80° 69° S.E. 1.5	7 70 Wh., bk., rd. S. 80° 60° S.E. 1.5	7 111 gn. S. 80½° 54° S.E. 1.5	4 123 Co 81° 52° o	4¾ 159 .... 81½° 49° N.W.×W. 0.75	5 182 Wh., bk S 80½° 47° N.W.×W. 0.75	5 224 S. G. 82° 47° N.W.×W. 0.75	5½ 278 Fne S. 81¾° 43° N.W.×W. 0.75	6¼ 349 Co. R 81° 44° N.E.¾E 1.7	6 377 Co. 83° 42½° N.E.⅓E 1.7	6¼ 503 Co. 83½° 38½° N.E.×E.¼E 3.5	6⅝ 460 Co. 83° 46° N.E.×E.¼E. 3.5	6¼ 451 Co 83° 46° N.E.×E.¾E. 3.5	6¼ 512 .... 82½° 39° N.E.×E. 2.5	6 595 Co. S. 82½° 38½° N.E.×E. 1.5	6 637 Ptd. oz. 82° 38½° N.E.×E.¾E. 1.5	6 902 Ptd. oz. 81¾° 38½° N.E.×E.¾E. 1.5	6 1241 Ptd oz. .... 37° N.E.×E.¾E. 1	35¾ 1672 Ptd oz. .... 36¾° o	....	....	....	....	....	....

LINE I. FROM CAPE FEAR TO LAT. 32° 05′ N., LONG. 76° 09′ W.

10¾ 19 Brk. Sh. 81° 72° o	10¼ 21 Crs S. 81° 66½° o	7 21 Fne gy. S. 82° 66½° o	3¾ 54 S. G., brk. Sh 83° 63° o	4¾ 92 .... 82½° 55° o	3⅓ 129 .... 82° 50° N.W.×W. 2	3½ 164 gy. S. 82½° 47½° N.W.×W. 2	3⅛ 184 .... 82° 45½° N.W.×W. 2	3¾ 209 .... 83° 45° N.E.½N. 2	3⅛ 238 .... 84° 43° N.E.½N. 2	2¾ 259 S. 84½° 46° N.N.E. 5	1⅔ 286 Bk., wh. S. 84½° 45° N.N.E. 5	2 319 Bk., wh. S. 84° 44° N.N.E. 5	1⅔ 338 Glob. 84° 41° N.N.E. 5	3 364 Glob. 84° 42° N.N.E. 2.5	3 386 Glob. 84° 43° N.N.E. 2.5	3¼ 410 Glob. oz. 84° 43° N.N.E. 2.5	3¼ 434 Glob. oz. 84° 42° N.N.E. 2.5	3¼ 459 Glob. oz. 84° 42° N.N.E. 2.3	3¼ 492 Glob. oz. 84° 40° N.N.E. 2.3	3 535 Glob. oz. 84° 40° N.N.E. 2.3	2⅔ 605 Glob. oz. 84° 39° N.N.E. 2.3	3½ 7[illegible]9 Glob. oz. 84° 38½° N.N.E. 2.3	4¾ 959 Glob. oz. 83° 38° o	4⅜ 1189 Glob. oz 83½° 27½° o	9 1288 Glob. oz. 83½° 37½° o	7 1351 Glob. oz. 83½° 37½° o	5⅝ 1406 Glob. oz. 82½° 37° o

LINE J. FROM CAPE LOOKOUT, N. C., TO LAT. 34° 09′ N., LONG. 75° 22′ W.

[illegible] 19 Fne gy. S. 83½° 75°	1 36 .... 83° 62° N.E.×N. 1.75	5 107 .... 84° 58½° N.E.×N. 1.75	5 242 Brk. Sh. 86° 43½° N.E.×N. 1.75	4 527 Glob. oz. 86° 32° N.E.½E 2.75	6½ 1494 Glob oz. 85° 37½° N.E.½E 2.75	11¾ 2046 Glob oz 85° 36° N.E.½E 2.75	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....

LINE K. FROM CAPE HATTERAS TO LAT. 35° 21′ N., LONG. 74° 20′ W.

14½ 35 .... 75½° 66° E.N.E. 2.5	2 66 .... 83° 32° E.N.E. 2.5	2 303 Glob. oz. 82½° 41½° E.N.E. 2.5	2⅛ 427 Glob. oz. 84° 40° E.N.E. 2.5	4½ 1221 Glob. oz. 84° 37½° E.N.E. 2.5	5 1458 Glob. oz. 84° 37½° E.N.E. 2.5	7⅛ 1560 Glob. oz 84½° 37½° E.×N. 3	7⅛ 1609 Glob. oz. 84½° 37½° E. 4	¾ 1643 Glob oz. 84° 37½° E. 4	1¾ 1627 Glob oz 84° 37° E. 3	1⅛ 1756 Glob oz. 83½° 36½° E. 3	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....

LINE K‴. FROM CAPE HATTERAS TO LAT. 34° 37′ N., LONG. 75° 17′ W.

8½ 2[illegible]	3½ 20	4 25	4 30	5 116 S. brk. Sh. 82° 48½° S.W. 0.7	2⅔ 189 S. brk. Sh. 82° 45° S.W. 0.7	3¼ 378 Glob. oz. 82½° 39° S.W. 0.7	2 999 Glob. oz. 82° 38½° S.W. 0.7	3 1309 Glob. oz. 82° 38° S.W. 0.7	3 1361 Glob. oz. 83° 37½° S.W. 0.7	....	....	....

LINE L. FROM CURRITUCK, N. C., TO LAT. 36° 12′ N., LONG. 74° 17′ W.

10⅞ 15 .... 75° 5[illegible]° W. 0.5	13 15 .... 75° 52° S.W. 0.5	10¾ 21 Fne S. 77½° 49° S.W. 0.5	4⅛ 24 .... 77° 46° S.W. 0.5	4¼ 24 G., brk. Sh. 77° 43° S.W. 0.5	4 51 S., brk. Sh 76½° .... S.W. 0.5	2⅞ 196 Fne. gn S 76° 42° S.W. 0.5	2½ 536 Glob oz. 76° 39° S.W. 0.5	2⅝ 677 Glob. oz. 76° 38° S.W. 0.5	2⅞ 749 Glob. oz. 77° 38° S.W. 0.5	5 887 Glob. oz 76½° 37½° S.W. 0.5	4⅝ 1095 Glob. oz. 76° 37° S.W. 0.5	5 1165 Glob. oz. 76½° 37° S.W. 0.5	....	....	....	....	....	....	....	....	....	....	....	....	....	....

[illegible] Distances between soundings are given in nautical miles, the first sounding being measured from the shore. The abbreviations for character of bottom are: Fne., fine; bk., black; gy., grey; wh., white; rd., red; gn., green: brk. Sh., broken shells; S., sand; G., gravel; sp., specks; Co., coral; Co. R., coral rock; Ptd. oz., Pteropod ooze; Glob. oz., Globigerina ooze. [illegible] was on June 1st, and they were continued to the northward during June and July. The lines were run during day and night, but we crossed the stream in the daytime. As mentioned in the essay, the direction of the current was very much influenced by direction and force of the wind.

J. R. B.

NAVAL INSTITUTE, ANNAPOLIS, MD.

MAY 18, 1882.

LIEUTENANT T. B. M. MASON, U. S. N., in the Chair.

HIGH-POWERED GUNS: A STUDY.

BY LIEUT. E. W. VERY, U. S. N.

MR. CHAIRMAN: The substance of what I have the honor to submit to you this evening I have called a study. Not that I am afflicted with the fashionable disease of æstheticism, but because many of the deductions which I shall make are based upon conditions that are true only for the present, and under the supposition that though they are correct they do not invalidate dissimilar developments worked up from the same bases. I also wish to stamp this lecture with the seal of belligerency by denominating it a study, in contradistinction to many of the hastily conceived notions that are now so freely circulated.

Within the past six months great interest has been aroused in the general subject of the reorganization of the materiel of the Navy, and, as appertaining to it, the armaments of our ships. Scarcely a week passes that we do not have an opportunity of reading individual opinions on these subjects published in the public journals. Many of these articles not only contain valuable information as to what is being done abroad, but they present wise deductions resulting from careful study of this information. On the other hand, by far the greater number are, in my opinion, the expression of passing notions, valuable in nothing beyond the exposition of the conceit of the writer, who treats familiarly subjects which demand the deepest thought.

Mr. Worldly Wiseman throws off a few grandiloquent phrases about the boundless resources of the country; talks in a cosily familiar way

of seventeen-inch guns and twelve thousand ton ironclads; pooh-poohs the pop-guns recommended by the Advisory Board; suggests, half sneeringly and half in earnest, that we go to Krupp or Armstrong if we cannot make guns of our own; and so on ad infinitum.

For the past twenty years there has been a standing advertisement before the American public, that may be read as follows: *Wanted—Guns for the Navy;* and in answer to this advertisement we have had suggestions of every conceivable type and calibre, from the half-inch Gatling to the seventeen-inch Armstrong. A short time ago the Naval Advisory Board published its opinion that our immediate necessities demanded guns suitable for modern unarmored cruisers of between 3000 and 6000 tons. As a member of that Board, and one of those to whom was entrusted the regulation of the ordnance recommended, I consider it appropriate that I should take this recommendation as the basis of my development, and at the same time I will open my attack upon the hasty naval paragraphers whose nerves have been unstrung at the idea of such a paltry recommendation as that of an unarmored fleet. Their argument in opposition to it is this: "We agree with the Board that the destruction of an enemy's commerce is one of the first objects, if not the main one, to be accomplished by the United States in a war with a foreign power. But why turn all the energy and capital of the Navy to the construction of an unarmored fleet for this purpose, when the same object can be accomplished so easily by calling into service the fast steamers of our merchant fleet, arming and equipping them and sending them out? It is only necessary to give them batteries of a half-dozen Hotchkiss 2½ inch revolving cannon, which can pierce the sides of merchant ships at 2000 yards, and sweep their decks with shrapnel at 4000, and with a few internal modifications send them right off." That is, having given a private steamer with a satisfactory endurance and rate of speed, it is only necessary to provide her with an offensive power that shall enable her to overcome foreign commercial vessels.

This style of argument shows that such a writer has succeeded in understanding what is meant by high-powered guns, just enough to see the advantages in them without appreciating to what a condition such a development leads. In former times when offensive power on the sea was synonymous with dead weight of battery, a ship had to choose between cargo and guns; she could not carry both, and must be either wholly a man-of-war or wholly a commercial vessel. The introduction of Hotchkiss guns and artillery of a kindred nature has made a complete revolution in this respect.

I am not far from the mark in stating that a battery of six $2\frac{1}{2}$ inch Hotchkiss guns with its ammunition, which makes a decidedly snug outfit for depredations on commerce, would weigh about ten tons. Allowing two men to a gun, and twelve additional for the ammunition supply, we have 24 men for their service, which is an ordinary crew for a merchantman. The weight is so scattered that vessels of the most ordinary scantling can carry such a battery. Now I ask: Does it not seem a most ordinary *defensive* operation that either ship-owners of the enemy, or their government acting for them, should equip their line steamers in this fashion? They can easily carry the armament and their cargoes as well. If we call in our merchant vessels and arm them in a similar way, we deprive ourselves of their revenues and are not a whit farther advanced, for we have but placed these vessels on a par with similar ones of the enemy, and, owing to the weakness of the ships on both sides for fighting purposes, victory is more a matter of chance than power.

But in addition to our loss of revenue, we have accepted a most grave risk; for suppose that in a fight between two ships an event should occur that may reasonably be expected: that is, that an enemy's vessel loaded with freight and on her course towards her destination, should, with her force, capture or sink a single one of our metamorphosed ships. So sure as that the sun will rise to-morrow, press and people would cry out and demand the immediate abolition of such a system, and a substitution therefor of fighting vessels. A single victory of a cargo-laden ship over a metamorphosed vessel would reduce insurance rates and give confidence to the shipowners of the enemy: exactly what it is our main object to prevent. On our own side there would be loss of confidence, loss of prestige and confusion. Is it then wise to depend upon or even recommend such a system with so grave a risk attached?

But suppose we go a step farther with these vessels and make them superior to these line steamers by providing them with guns, shields and compartments. We not only have the judgment of our own common sense, but the experience of Great Britain, in the failure of her attempts for ten years, backed by offers of a liberal subsidy, to prove that shipowners will not provide the compartment division and strength of scantling necessary for war service in building their ships. The war must come first, and when it comes the government must do the work. I submit to you again, is it the part of wisdom to add this burden of doubtful utility to the war distractions of the govern-

ment? Shall the keels of our armored ships be made to wait for the space in our docks occupied by these semi-men-of-war? I say No! Let there be no dependence on such half measures. The enemy's commerce must be struck and broken down, and we must have the instruments that are certain in execution. Let them be built now, and keep the peace by serving as a standing menace against belligerent commerce. We have no choice about arming our merchant fleet; it must and will be, but let it remain in its proper channel where it will be a real benefit in keeping up our revenues, and let us provide it with guns that it may be, as far as possible, self-defending, and if opportunity offers, belligerent.

I will call attention to one point that the Hotchkiss type of weapon has developed. Ever since the treaty of Paris, Englishmen have mourned the deprivation of the advantages which privateering offered them. Now, the value of the privateering clause in that treaty is less than the paper on which it is written. British cargo ships will go to sea armed. If they are not attacked their commercial object is accomplished, but if one shot is fired they may, in self-defence, fight and capture their opponent and bring him in a lawful prize without violating a syllable of the treaty.

From this point of view of the subject, then, it seems to me that the first necessity in the provision of guns for the Navy is to obtain such as are suited to unarmored men-of-war; and were it not that I should treat of subjects outside the bounds of this lecture, I could prove the necessity for an additional limitation to guns for ships of between 3000 and 6000 tons.

In developing these guns, the first thing that we must fix our attention upon is the main purpose for which we need them. I have already stated that I consider one of the main objects to be the destruction of an enemy's commerce, and since the enemy will try to harm us in the same way and by the same means, our men-of-war must be in condition to meet them with equal power. In the face of steel deck plates and protecting coal bunkers, the Hotchkiss gun is deficient in power; therefore we must provide larger calibres. Shall we choose an armament composed of very few guns of the highest possible power, or one of as many guns as we can get that are fully capable of accomplishing the work in hand? I have read a great deal lately of the immense advantage to be obtained by arming our cruisers with a couple of ten-inch guns instead of the Advisory Board pop-guns. Many of those who advocate such an armament are very

well aware that a gun of half the power of the ten-inch is fully competent to overcome the defensive power of any unarmored vessel afloat. The reason given for the recommendation is that the heavier gun would be extremely useful in case an ironclad were met with. So it would, and so would great sail-power in case the engines broke down, which is a circumstance fully as likely to happen, yet the advocates of the big guns are unanimous in cutting down sail-power to the lowest limit. Such arguments are illogical. You may if you choose ignore all secondary chances, but if you allow for one then allow for all, and give them the allowance that their importance demands. Since these unarmored vessels are not intended to fight ironclads, it is certainly improper to give them a battery to meet those ships, and so sacrifice their utility for their proper object. The 6-inch gun has power enough to overcome all obstructions in purely unarmored vessels at ordinary fighting ranges, except perhaps under a few exceptional circumstances, and since four 6-inch guns can be carried for each 10-inch, the real power of the ship is increased four times, since a projectile to do harm must hit the right spot, and gunnery at sea is an uncertain element. Since the 6-inch will not serve infallibly, is it not wise to go a little higher and provide, not one or two 10-inch, but double the number of 8-inch guns, which are just as well suited for the work in hand?

Just here I wish to call your attention to another sad blunder of the hasty writers. They are fond of saying that it has always been the successful policy of our service to arm our ships with but few guns and those of the heaviest calibres. This is all an error. The Constitution, the Essex, and the Enterprise, types of our first successes in naval architecture, carried not only more powerful guns, but more of them than any vessels of their own class which they fought. Later, when shell-fire introduced a new element in gun-power, the Powhatan, Mississippi, and Susquehanna appeared, carrying more powerful guns and more of them than any ships of their class in the world. Again, in '57 appeared the Wabash, the Hartford, and the Iroquois, with more powerful guns and more of them than any vessels of their class in the world. Here we must stop, for at this point the development of ordnance in our navy ceases. I will but call attention to the single failure ever made in armament on our side of the water. I refer to the Niagara, with her 11-inch battery. Here is the result of a practical application of the idea of a couple of 10-inch rifles.

This principle, then, of adopting guns that will certainly accomplish the work in hand, and arming the ships with as many as possible, is the successful policy followed by our forefathers through all changes, from small ships to large ones, from sail-power to steam-power, from solid shot to shell-fire, and from paddle to screw propulsion. It is the policy recommended by the Advisory Board, and I firmly believe it to be the only true one.

Having thus reduced the general question of guns to the consideration of two calibres as being the ones about which we must first concern ourselves, I turn to the subject of the development of these guns, and in so doing I may drop one calibre, as the same development, whatever it be, may be followed in both cases. These guns must match corresponding foreign guns in power, as follows from what I have already said. Now, what is the power of, let us say, the foreign 6-inch gun? I find from examining records of foreign practice that these guns have about 94 foot-tons of energy per inch of shot circumference for the service projectile. Just here I must note another exception to the language of the soidisant expert professional writers, who preach a deal about the necessity for guns of long range. The expression is about as definite as if they said that our guns should be as big as a rock. Once in a while they become somewhat more definite, and say that our guns should range eight or ten miles, and I am tempted to surmise that the writer has some idea that that is about a good fighting distance. Now, we do want great range once in a very great while, and when we do, we Navy people, with our extreme elevations of 15°, are obliged to make extraordinary and special preparations for it. Range as a measure of gun-power is simply absurd in naval artillery. The work that a projectile will do is the measure of the power of the gun, whether it be to penetrate air or iron, and since we must have some standard of measure and comparison, the ordnance world have tacitly agreed to assume as the standard the penetrating power into iron plates; or since this power varies most nearly as the energy per inch of shot's circumference, that is taken as the standard. I mention this so that in future when the penetration of shot into iron armor is mentioned, the soreheads will be warned not to expatiate on the fact that iron armor is obsolete. Just so in coinage, the mill is obsolete if it ever had any tangible existence, but ten mills make one cent all the same.

Now, this power of penetration or energy of a projectile is made up of two factors, weight and velocity; and if we can make either or

both of these factors larger than they are in foreign guns we shall have a more powerful weapon. Let us make the attempt and see how we shall come out. By actual construction, and, in fact, from the records of foreign experiments, it will be found that a 6-inch projectile may be made that will weigh over 100 lbs. without passing the limits of dimensions consistent with the conditions of accuracy and general practicability. We will, therefore, assume a weight of 80 lbs., which presents no difficulty of application. This is one factor, and it is 5 lbs. more than the corresponding one used abroad. In Europe we find the average velocity to be 1850 feet per second at the muzzle. Whether we can safely increase this factor or not is what we must next consider, and this leads us from the projectile to the cartridge.

A certain amount of powder can produce a certain amount of elastic gas, which is the propelling power, and it needs no demonstration to prove that the pressure which this gas will produce, or the work that it can be made to do, depends upon the size of the space in which it is confined. Suppose that we have a certain amount of powder-gas behind a projectile; or, in other words, let the explosion of the charge of powder be complete before the projectile commences to move. A certain pressure on the wall of the bore and the base of the projectile is produced, and this is called the Maximum Pressure, because, all of the gas being evolved and the space not being subject to reduction, no greater pressure can be produced. Now, if the projectile starts along the bore the pressure will be reduced, for the space is growing larger and the gas is doing work. If we knew just how much pressure a certain amount of powder would create in a certain space, we might divide the whole bore into spaces that would bear a certain relation to the charge, and at the points of division we could erect ordinates whose length would represent the pressure at those points. As a matter of fact this has been done for us by foreign experimenters; so having assumed a certain charge of powder and shape of bore, we erect these ordinates, and if we join them by a curve, which we call the Curve of Pressures, we shall have an area inside of this curve which exactly expresses the amount of work done by the powder-gas. This is precisely what we want, for knowing the weight of our projectile and the amount of work imparted to it by the powder-gas, we can find the velocity.

We must put a limit upon the amount of maximum pressure that we shall force the gun to stand, and since, as we have already seen,

this depends upon the space within which the gas expands, we know how large to make the powder chamber. Again, since the gas will continue to do effective work or increase the velocity of the projectile as long as its pressure is greater than the resistance of the air and the friction of the projectile, we have a guide to the proper length of bore, which in practice is limited more by the conditions of service than by the maximum utility of the powder-gas.

This is the general explanation of the manner in which the interior ballistics of a gun is treated. The actual work of course requires many refinements, checks, and tentative operations that cannot be well enumerated here. There is, however, one point upon which I will touch, as I think there are many who have erroneous ideas with regard to it. That is with regard to quick and slow burning powder. Let us take a sample of the same weight of each kind and suppose them to have the same proportions of ingredients. They differ only in size, shape of grain and density. Since there is the same amount and the same mixture in both samples, they will produce the same amount of gas and do exactly the same total amount of work. But herein lies the difference in their effects. The quick powder is completely exploded before the projectile starts, hence the maximum pressure is high, owing to the small space. The slow powder, however, is not exploded until the projectile has moved some distance, so that as the space is larger the maximum pressure is less. If the projectile be very light it will move off under a light pressure, so that within reasonable limits of length the gas could not get its work in effectively, so to speak. Therefore with light projectiles slow powder will not do. The difference in action between powders is mainly due to physical surroundings, and not to anything inherent in the powder itself. This explains why the receipt for powder-making has not changed since the days of its discovery, and it is a very good reason for regarding new-fangled powders with suspicion when they are proposed for use in firearms.

Thus far we have succeeded in establishing a weight of projectile and a velocity that appear satisfactory, and we have a pressure curve which must be the guide in constructing the gun so that its strength may be properly apportioned. We come now to the actual building of the gun, and the first point to be settled is with regard to the material. I do not propose to detain you long in the discussion of this point, for I think that I can give an unanswerable reason for my choice. For the purpose of illustration I will take up the two suc-

cessful European systems: the English wrought iron and the Prussian steel. To serve my purpose I will quote from a lecture given by Colonel Maitland, of the Royal Engineers, before the Society of Arts. He says:

" From among a cloud of proposals, experiments and inventions, two great systems at length disentangled themselves. They were the English construction of built-up wrought iron coils, and the Prussian construction of solid steel castings. Since the early days, great improvements have taken place in the qualities of both materials, but more especially in that of steel. Still the same general characteristics were to be noted, and it may be broadly stated that England chose confessedly the weaker material, as being more under control, cheaper, and safer to entrust with the lives of men; while Prussia selected the stronger but less manageable substance, in the hope of improving its uniformity and rendering it thoroughly trustworthy. The difference in strength when both are sound is great. Roughly, gun-steel is about twice as strong as wrought iron."

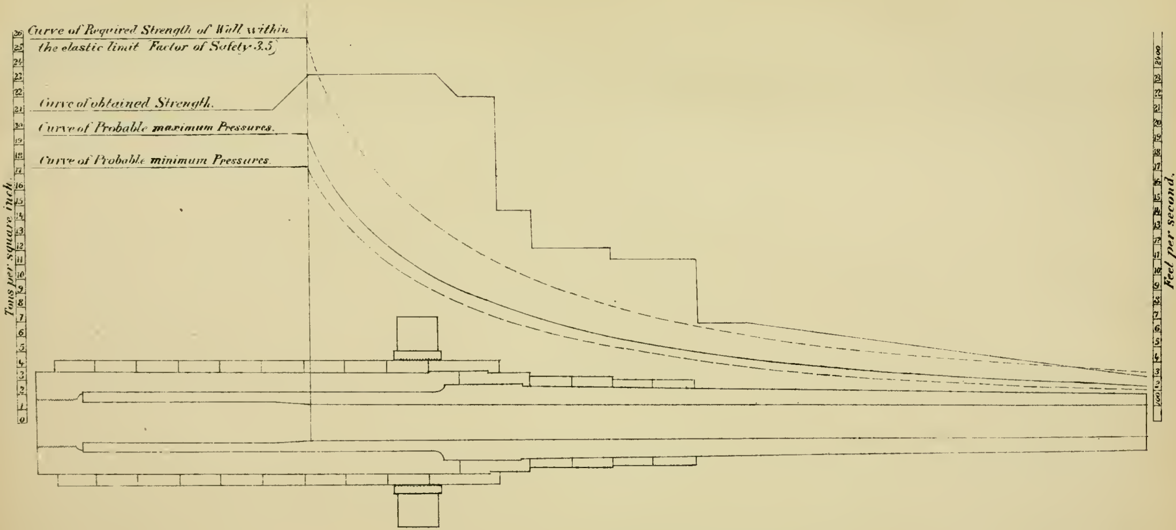
Here, gentlemen, is the evidence of one of the highest authorities in the world on ordnance. He says frankly that England chose the weaker of two metals, and gives his reasons therefor. Let us examine the results of that choice. We go back to 1862 when the Armstrong system of construction may be said to have appeared fully developed in guns that had no superior; development went on with rapid strides, bringing out powerful and successful guns that defied the world; from the 7-inch to the 10-inch was but a step; then on to the Woolwich Infant, which was the pride of England. Here development halted. Muzzle-loading became cumbersome; studded shot cracked the tubes; short guns became weak in power, and change was the order of the day. The studs slowly give way to expanding gas-checks, the bore grows longer, the chamber is enlarged, and suddenly we wake to find a complete revolution made at one step, and steel guns, breech-loading, large chambers and tight-fitting projectiles are adopted at once. Turn now to Prussia and follow her through her early struggles with her steel breech-loaders; the guns will not stand heavy charges, the belts of the projectiles are bad, the powder is poor. Failure after failure is announced, until her Artillery Board almost despair when the Prussian navy rebels against the dangerous breech mechanism and demands the muzzle-loaders like the English. All is due to that uncertain metal, steel. The government demands that an English nine-inch gun be put on the German

firing-ground, and that the experts stake their reputations on a competitive contest. It is a conflict of principle, and the Committee gathers itself for one supreme effort. The result is proclaimed to the world, and the famous Doppelmair experiments give victory to Prussia. On the 7th of July, 1868, the Woolwich 9-inch muzzle-loader thundered out its funeral salute on the firing-ground at Tegel. Prismatic powder, enlarged chamber, tight-fitting projectiles, breech mechanism, and true steel to bind all together, send the Prussian system to the front. The metal won the day, and from then on until the present, Prussia has plodded on in her development of the best material. Long after the Doppelmair experiments the English closed their eyes to their position ; but when the German guns sounded again at Meppen in 1879, the warning had to be heeded ; and steel, the best metal and the only metal fit to do the work, took the place, throughout the world, that belonged to it.

Steel, then, I will choose for my gun in any event ; for power is demanded to-day, and more power will be demanded to-morrow ; and though cast-iron may control the power we now exercise, it will not do, nor will any other metal than steel do for what power we want and must have very soon.

The next point is as to the application of the steel ; and here I will dispose directly of one branch of the subject, namely, wire-winding. I thoroughly believe in it as a most valuable factor in gun construction. As yet, however, too little is known of it to warrant us in designing service-guns on any of the systems. It must and doubtless will be experimented with and developed ; and here one word for my chronic grumblers who have got a new grievance in the Armstrong and Schultz systems. I will tell them that the Woodbridge system is not only purely American and much older than either of the others, but as much superior to them as steel is superior to cast-iron.

I would not take up your time with any discussion of the question of solid or built-up guns, were it not for the notions which are from time to time published with regard to the comparative reliability of the two systems. We hear a great deal about a built-up gun being a compromise and as such very inferior to a good solid one. In a theoretical discussion of the strains to which the gun will be subjected, the term compromise is admissible, but practically it is the veriest bosh. An exactly parallel case is that of the possibility of dealing with infinitesimals in mechanical discussions, which cannot be done practically. We might with just as much truth say that a built-up ship is a com-


Curve of Required Strength of Wall within
the elastic limit (Factor of Safety 3.5)
Curve of obtained Strength.
Curve of Probable maximum Pressures.
Curve of Probable minimum Pressures.
Tons per square inch.
Feet per second.

promise, rivet holes are sources of weakness, and butts, joints and rivets are positive nuisances. Yet I do not think any one will hesitate to say that were it possible and even economical to solid-cast a ship and then dig her out, such a course would never be resorted to, for the built-up ship, with all her drawbacks, would be the better.

As a guide in building the gun, I have, as you see, determined and laid down a curve of pressures, and since all good structures possess a margin of superfluous strength I adopt a factor of safety of $3\frac{1}{2}$; that is, the gun must be able to withstand a strain $3\frac{1}{2}$ times greater than any that we propose to subject it to. Having chosen the metal, we must fix upon the qualities desired of each piece that is to go into the gun in order to secure the best result. I find from what I know of the qualities of steel and the possibilities of production that I shall be satisfied with a medium soft quality for the tube; a steel of 65,000 lbs. tensile strength and 25 per cent. elongation. For the jacket I want a stronger metal, let us say 80,000 lbs. with twelve per cent. elongation. For the hoops still stronger metal is desired, and I shall insist on 95,000 lbs. with eight per cent. elongation.

In these first guns we shall depart from European custom quite radically in one respect, and that is in not oil-tempering the tube ; one of the main reasons being the uncertainty at the start that we shall get our shrinkages exactly as we want them, and all the parts perfectly adjusted. By leaving the tube moderately soft we run the risk of deforming the powder chamber by overstraining in firing and scoring the bore badly ; but if we do not overstrain the tube all will be secure. If we do, paradoxical as it may appear at first sight, we shall strengthen the gun. By overstraining the tube the same effect is produced as is the case with bronze gun-tubes, which, as you know, are made almost equal to steel by mandreling out, or overstraining the inner layers of the metal. Do not lose sight of the fact, as many do, that I am speaking of the tube alone. If the gun-wall is overstrained throughout, it is weakened as a matter of course. I have great curiosity with regard to this point, for if we find that we can carry high charges without scoring the bore badly, I should recommend by all means a moderate untempered tube and an oil-tempered jacket, so as to gain strength there and reduce the weight of the gun proportionally. It is also my opinion, resulting from what I have seen on the practice-ground, that soft steel will not score as quickly as hard steel, the principle being the same as that of the effect of the sand-blast. As you all know, the latter will cut rapidly

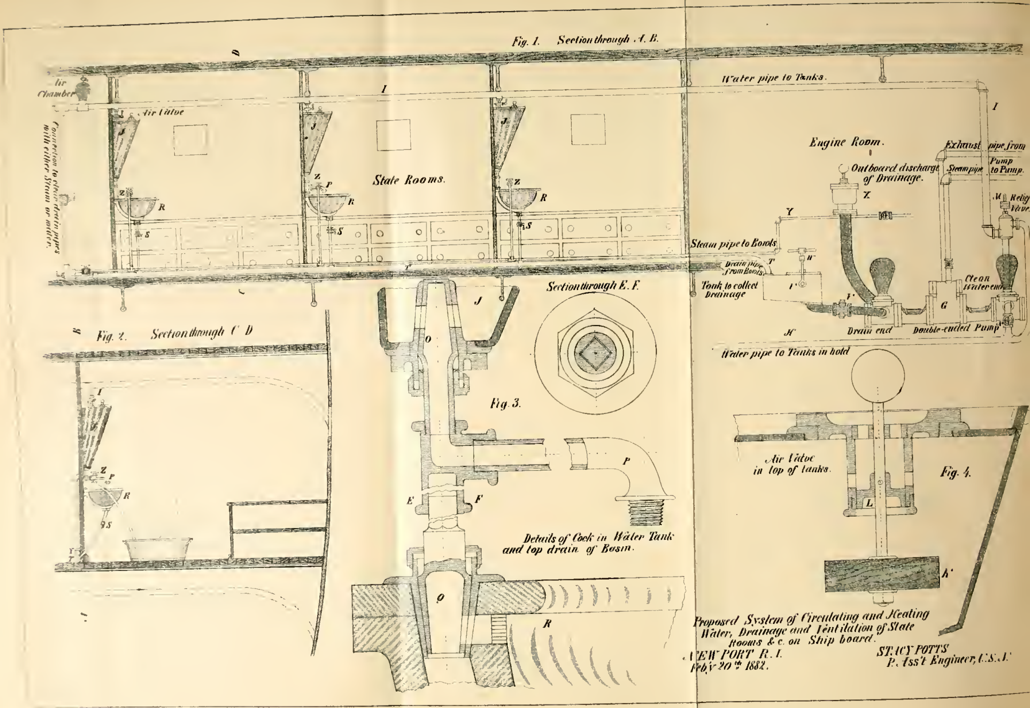
into any hard surface, whilst the softer the material the less pronounced is the effect of the blast.

We now come to the actual dimensions. I am limited in thickness of tube by several circumstances. First, the lower limit of thickness is controlled by the diameter of the powder-chamber which has already been established. Second, the upper limit is controlled, forward by the strength required in the chase of the gun, and in rear by the size of breech-aperture, arrangement of jacket and size of lodgment for the gas-check. The size of the jacket is limited by two main considerations. Being under any circumstances a very thick forging, its diameter should be kept down as low as possible, so that it may be as perfect in structure as the hammer can make it. At the same time, since I propose to make it bear the entire longitudinal strain, its cross section must be large enough to safely stand it. It must reach in length as far as the trunnions, as the longitudinal strain must be transferred directly from the jacket to the trunnion hoop. With the hoops I am limited only in width. The hoops are made in rolls used for the manufacture of car-wheel tires, and the width of seven inches is the extreme that the rolls will work. This is not really a drawback, as twelve inches would be the maximum desired under any circumstances.

I have now reached the final point of assembling the parts of the gun into a single solid structure. In shrinking the jacket over the tube I will slip it on from the rear, since in this manner I can overlap the end of the tube and thus get a small breech-block. As you see I relieve the tube from all longitudinal work and give it to the jacket, which as a heavier and stronger piece is better able to bear it. In order to transmit the strains directly to the trunnions I turn down the jacket, leaving a jog at the forward end, against which the forward hoop of the rear section abuts. Since the tube must not be permitted to drift either way in firing, I leave a raised section just forward of the trunnions, which serves a double purpose; it gives jogs by which it can be secured against movement, and it gives an increase of strength at the joint where the forward and rear sections of the gun meet. The hoop slipped on from forward abuts against the jog on the tube and the forward end of the jacket, of which it is practically a continuation. Over this joint is slipped another ring, jogged to its lower companion, and these two rings meeting under the trunnion-hoop are threaded, and the latter is screwed on cold, practically binding the two sections of the gun together. The application of the rest of the rings requires no explanation.

This, then, is the finished gun, and its strength, as you see by the irregular curve, is above the limit of safety required, except over the powder chamber, where the factor of safety is a little over two. This is no real weakness, however, for if the jacket be oil-tempered the factor will rise to four, and if without oil-tempering the tube be overstrained in firing, it will rise to three. At any rate it will, as it is, stand twice the strain that we propose to bring upon it. As constructed, this gun with all its attachments will weigh about 10,800 lbs. It is, if anything, a shade lighter than the foreign guns of twenty-six calibres would be if they were of the same length.

I will now close my lecture, gentlemen, thanking you for kind attention, and trusting that I have proved to you that in this gun not a step has been taken, from the original determination of its calibre up to the finished object, without a careful study and a sound reason. Here is a high-powered gun that is neither modeled from Krupp nor Armstrong. It is American throughout, and there is not a stronger or more effective gun for its weight in the world to-day. It will have as its average power 118 foot-tons per inch of shot's circumference, or sufficient to pierce 11 inches of iron. Its maximum power may safely be placed at 135 foot-tons, or sufficient to pierce twelve inches of iron armor.



Proposed System of Circulating and Heating Water, Drainage and Ventilation of State Rooms &c. on Ship board.

NEWPORT R. I.
Feb'y 20th 1882.

STACY POTTS
P. Ass't Engineer, U.S.N.

NAVAL INSTITUTE, ANNAPOLIS, MD.

PROPOSED SYSTEM OF CIRCULATING AND HEATING WATER, DRAINAGE AND VENTILATION OF STATE ROOMS, &c., ON SHIP-BOARD.

By P. Asst. Engineer Stacy Potts, U. S. N.

We must start out with the fact that steam is to be kept up at all times, and, in our coming man-of-war, this will be found absolutely necessary for other purposes, such as pumping, capstans, heating, &c. The ships will probably be fitted with a number of compound boilers, any one of which can be used at certain times; if fitted otherwise, at least two auxiliary boilers should be on board, one in use while the other is being put in proper working condition.

Situated at a convenient place in the engine-room is a double-ended steam-pump *G* (Fig. 1), the forward end of which is used for circulating the clean fresh water only, and the after end for the drainage. The suction pipe *H* leads to the fresh-water tanks in the holds, and the water is forced through the discharge pipe *I* into a small copper tank *J* in each state-room, or to any part of the ship where it may be required. In the top of each tank *J* is an automatic air-valve (Fig. 4), which allows the air to escape as the tank fills, and finally closes as the water rises, lifting with it the float *K* and valve *L*, thus preventing an overflow of the water into the room.

When all the tanks and pipes are filled, the relief valve *M* opens and allows the water to pass back to the suction side of the pump; if the attendant notices the relief-valve *M* working, he simply closes the valve *N* on the suction side of the pump, still keeping the pump running for the drain end; if the attendant is not present when the relief-valve *M* commences to work, the water will only be churned from one side of the pump to the other with no danger of bursting the tanks, &c. In the bottom of each tank *J* is fitted a plug-cock

O (Fig. 3), which connects with the spigot *P*, forming the handle of the cock also. Another plug-cock *Q*, fitted in the top overflow pipe of the marble basin, and top *R* is worked by the same handle *P*, and the ports in the cock *Q* are so situated as to *close the drain or overflow when the water is not running into the basin, and to open the overflow only while the basin is being filled, thus preventing any stench from the drain coming through this opening*, should the pump cease working. The connection between the top and bottom plugs is free to move in a vertical direction, thus allowing for the working of the ship between the tank and basin. The basins *R* are fitted with the ordinary strainer and cone plug, of either composition or rubber, in the bottom, which is secured to the spigot with a small chain.

In the drain pipe from each basin are plug-cocks *S*, which are to be closed when blowing through the main drain pipe. All the drain pipes lead into the main drain pipe *T* (Fig. 1), which in the figure is shown as running along the inboard side of the bulkhead; but this position is not absolutely necessary, as any other one—on the deck below, or amidships, where as straight a lead and slight inclination could be given, would answer all purposes. This main drain pipe terminates in a tank *U*, situated near the pump *G*. This tank is fitted with a pipe connection, and cock *V* leading to the suction side of the drain end of the pump *G*; also a large manhole and plate, the latter made easily removable for cleansing purposes by the swinging yoke and clamp *W*. As the pump *G* is continually running, the tank and drain pipes are kept exhausted, the drainage going overboard through the check-valve *X*. Running alongside of the main drain pipe *T* is represented a steam-pipe *Y*, with branches terminating in a globe valve *Z* over each basin. In the after end of the ward-room these three pipes, viz. water *I*, drain *T*, and steam *Y*, are connected for the *purpose of cleaning the drain pipe by blowing steam through it, by pumping water through, or by combining both.* Each spigot *P* and steam-valve *Z* is fitted with a screw end for a coupling; each room being furnished with a short section of small rubber hose, which can be attached to either the spigot *P* or globe-valve *Z*. Say the hose is connected to the water spigot *P*, the other end can then be led in any direction, as for instance, filling a foot-tub which stands on the deck. *In order to heat the water in either basin or foot-tub, or to cleanse the top overflow, or bottom drain pipe, should they become foul or stopped up, remove the hose to the steam-valve Z.*

If the bottom stopper plug be left out of the basin, as our pump is continually running, *there will be a current of air drawn down through the drain pipe, thus keeping up a circulation of air, and consequently ventilation of the state-room.*

Should the drains become foul through the neglect of the "periodical blowing or pumping through process," no effect would be noticed in the state-rooms, provided the bottom plug be kept in its place, as the *top overflow pipe through which all previous troubles have been caused, is always closed except when water is running into the basin.*

NAVAL INSTITUTE, ANNAPOLIS, MD.

REAR-ADMIRAL JOHN RODGERS,

President of the Naval Institute, 1879–82.

By Prof. J. Russell Soley, U. S. N.

By the death of Rear-Admiral John Rodgers, the Naval Institute has lost a valued member, and one of its most faithful and active friends. In view of his early association with the society, the high office which he filled, and the warm respect and regard in which he was held by its members, it has been deemed fitting that at least a brief record of his long and honorable career should find a place in its proceedings.

John Rodgers was born August 8, 1812, in Harford County, Maryland. With him professional distinction was almost a birthright. His father, Commodore John Rodgers, was then at the zenith of his fame, and his uncle, Lieutenant George W. Rodgers, was destined to win his laurels in the war that had just begun. His grandfather, Colonel John Rodgers, had served with credit in command of a regiment from his native state during the Revolution; and, by placing his two sons in the Navy, had laid the foundation of that eminence which has made the name one of the most distinguished in our naval annals.

When in his sixteenth year, on the 18th of April, 1828, young Rodgers was appointed a Midshipman in the Navy; and on June 10, 1829, he was ordered to the Constellation, at that time about to sail for Europe on special service, under the command of Captain A. S. Wadsworth. Later she joined Biddle's squadron in the Mediterranean. Upon her return to the United States in 1831, Rodgers was transferred to the sloop Concord, under the command of Master Commandant M. C. Perry.

After three years and a half of sea-service, on December 16, 1832, Rodgers was detached and placed on waiting orders. He did not

long remain idle. Having taken his three months' respite from duty, he received permission, March 26, 1833, to attend the Naval School at Norfolk, and at the close of his term he was promoted to a Passed Midshipman, his warrant being dated June 14, 1834. Obtaining leave of absence, he wisely decided to make up, as far as possible, the scantiness, or rather the one-sidedness, of the training at the Navy Yard School, by passing a year in fruitful study at the University of Virginia.

After completing his University studies, Passed Midshipman Rodgers served a short apprenticeship in the Coast Survey, on board the schooner Jersey, to which he was ordered March 31, 1836; but in the following September he joined the brig Dolphin, then about to make her first cruise, on the Brazil station. Here he remained three years.

From 1839 to 1842 Rodgers was employed on the Florida coast, in command of small schooners, part of the time engaged in hydrographic work, and partly in co-operating actively in the campaign against the Seminoles. His first command was the Wave, to which he was ordered November 9, 1839. He was promoted to Lieutenant, January 28, 1840, having then been twelve years in the service, six of which he had passed in regular cruising vessels of the Navy. Later, he was transferred to the command of the Jefferson, a schooner employed on the same coast in similar duty.

From November 22, 1842, to January 9, 1844, Rodgers was attached to the brig Boxer, of the home squadron. Upon his detachment from this vessel, after a short leave, he was selected, May 7, 1844, to assist Lieutenant W. W. Hunter in superintending the construction of the steamer Alleghany, at Pittsburg. This duty was followed by a three years' cruise on the coast of Africa and in the Mediterranean, in the frigate United States, the flagship of Commodore George C. Read. Rodgers was ordered to the United States, May 5, 1846, and was detached February 22, 1849, upon her return to Norfolk.

On the 22d of April, 1849, Rodgers was again ordered to duty with the Coast Survey. He first commanded the steamer Hetzel, in which he was engaged in hydrographic surveys upon the coast of Florida. The charts which embody the work of these surveys yet remain the authority for navigators on this dangerous coast. While engaged in surveying the shoals off cape Canaveral, the Hetzel's cable parted, and she drifted into the breakers and was wrecked. The

steamer was thrown up on the beach, at a point far from any habitation. Rodgers at once bent all his energies to repairing her and getting her afloat. After caulking her and getting her into the water, it was found that she still leaked so badly that she would not swim; and, nothing daunted, her commander beached her again, and put her through a second process of caulking and repairing. Everybody but Rodgers regarded the attempt as hopeless; but the steamer was launched again, and by dint of constant pumping and bailing she managed to keep afloat. Finally she reached Key West, having succeeded in making the passage of 300 miles only through the energy and persistence of her commander, who had to beach her three times for repairs while on the way.

Rodgers was now assigned to the command of the Petrel, still on Coast Survey duty. While he was lying at Key West, a steamer came in from the coast of Cuba, having on board Lopez, the leader of the Cuban insurgents. She was hotly pursued by the Pizarro, a Spanish sloop-of-war of twenty guns. Rodgers promptly put his little schooner, armed with a single gun, between the fugitive and the pursuer, and by his daring and resolution prevented the Cuban's capture.

On the 12th of October, 1852, Rodgers was detached from the Coast Survey and ordered to duty in connection with the North Pacific Exploring and Surveying Expedition. The exploring squadron consisted of the Vincennes, flagship, the steamer John Hancock, the brig Porpoise, and the schooner Fenimore Cooper, and was under the command of Commander Cadwalader Ringgold. Rodgers commanded the John Hancock. The squadron left Hampton Roads, June 11, 1853, for the Indian ocean, stopping at Funchal, Port Praya, and Simon's bay. On the 12th of December the John Hancock arrived at Batavia. Five months were now occupied in surveying in the neighborhood of the large islands off the southeastern coast of Asia. Early in May, 1854, the John Hancock left Singapore for Hong Kong, where she arrived on the 24th of the same month. Here she joined the flagship, and here, or near here, the squadron remained during the summer.

The serious illness of Commander Ringgold now compelled him to give up the command of the expedition, and on the 11th of August Rodgers left the John Hancock for the Vincennes, succeeding to Commander Ringgold's place. After leaving Hong Kong, the squadron sailed for the Bonin islands, crossing the China sea. On the passage,

a succession of terrific typhoons was encountered, in one of which the Porpoise foundered. The commander-in-chief was always on the watch, and unwearied in his efforts for the safety of his ship. During ten days he had less than forty-eight hours of sleep; and thanks to his efforts, the Vincennes narrowly escaped the fate of her consort.

Several months were now spent in explorations and surveys among the Bonin islands, Loochoo, the Ladrones, and the Pescadores, and finally on the coast of Japan. The accuracy and care with which the surveys were conducted made the work of lasting benefit to commerce and navigation. With the able assistance of Lieutenant Brooke, whose ingenious apparatus for deep-sea sounding was first used in the Vincennes, results of the highest value were accomplished. In most of the work, Rodgers himself took a personal share, not merely by way of supervision, but as an accomplished and practised expert. In addition to his scientific work, the commander of the squadron was charged with delicate and exacting duties in creating and strengthening friendly relations with the natives of the islands. The people of Loochoo had violated the treaty concluded a few months before by Commodore Perry. Accordingly, Rodgers landed a force of seamen and marines, and, proceeding to Choui, exacted from the authorities guarantees for the future performance of their obligations.

After an interval of two months passed at Hong Kong, during February and March, 1855, the Vincennes returned to Loochoo to complete the work of surveying. Thence the expedition proceeded to the coast of Japan, and spent six weeks in careful and thorough exploration. On the 27th of June, the squadron finally left Hakodadi and sailed to the northward.

The Vincennes arrived at Petropaulovski, in Kamschatka, on the 8th of July, after having made full surveys of the sea of Ochotsk. After a week spent in sounding in Avatcha bay, she proceeded through alternate fog and rain to the harbor of Glassenappe. Here a house was built, and Lieutenant Brooke was left on shore with a party to make explorations and observations. The flagship pushed on through Behring straits and entered the Arctic ocean. Rodgers's object was to verify the position of land in about 72° N. and 175° W., which had been placed upon the Admiralty charts by Captain Kellett, of H. M. S. Herald, and to examine, if possible, Plover island, reported to have been seen by the same vessel. He further hoped to reach Wrangel land, which had been described by the natives to Wrangel as visible from cape Yakan in clear weather. Running over

the tail of Herald shoal, the Vincennes passed Herald island, and stood to the northward until she ran through the position of the land given on the Admiralty chart, and came to anchor on the 13th of August, in latitude 72°05′ N., longitude 174°37′ W. This was the highest latitude reached, and it was further than any previous explorer had penetrated in this direction. It was so clear that the horizon was apparently without limit; but no land could be seen from the royal yards, and the water, so far as the eye could reach, was free from ice.

Rodgers now returned to Herald island, and two boats were landed with exploring parties. The position of the southeast point of the island was determined in latitude 71°21′ N., longitude 175°20′ W. From the highest summit of the island no land could be seen in any direction, though the horizon was clear. Next day he proceeded on, and when about fifteen miles to the southward and westward of Herald island he got sight of the ice-pack. The ice could be seen from the deck from S. to W. by N., at a distance of ten miles, packed as far as the eye could see from the topmast-head. Later in the forenoon, the ship came within two miles of the ice barrier and was compelled to turn back. As she had nearly reached the alleged position of Plover island, and as no land could be seen from the masthead, though the air was clear, Rodgers was brought to the conclusion that Kellett had been mistaken, and that no such island existed.

Running for Wrangel land, which had never been seen by Europeans, Rodgers got within ten miles of its supposed position; but he was again arrested by barriers of ice. Having accomplished, as far as was possible, the object of his cruise, he returned to Glassenappe, beating against head winds all the way to the straits. Before reaching Glassenappe, he spent a week in surveying in and about the straits, in St. Lawrence bay, and about Siniavine, arriving at his old anchorage on the 6th of September, after a month's absence. Brooke and his party were taken on board, and the Vincennes proceeded directly to San Francisco, where she arrived on the 13th of October.

After four months spent in comparative rest and recuperation at San Francisco, the Vincennes put to sea again on the 2d of February, 1856. Surveying and deep-sea exploration still occupied the constant care and attention of the commander. Early in March, the ship arrived at Hilo, in the Sandwich islands, and three weeks were passed in surveying this harbor and the adjacent coast. The month of April was similarly employed in the Society islands, chiefly in and about the harbor of Papiete, in the island of Tahiti.

On the 29th of April Rodgers left Papiete, and turned his face finally homeward. Shaping his course around cape Horn to follow a great circle, he passed the longitude of the cape on the 24th of May, twenty-four days and fourteen hours from Tahiti, allowing for the difference in time. On the 12th of July, 1856, he arrived in New York, having sighted no land between Papiete and Sandy Hook, during his passage of seventy-four days. Five days later the Vincennes was put out of commission.

During his absence, on September 14, 1855, Rodgers had been commissioned a Commander. Though he had now fairly earned a long exemption from active duty, he contented himself with a brief respite of six weeks; and on the 30th of August he was ordered to special duty at Washington, in reducing the results of his observations. This duty lasted till the outbreak of the war; and, indeed, owing to the interruptions of the war, it was not fully completed until 1866. Since then, not a week has passed without showing the value of Rodgers's work; and had he accomplished nothing during his long career but the surveys of the North Pacific Exploring Expedition, the charts which bear his name would alone be a sufficient monument to his courage, his ability, and his usefulness.

Soon after the outbreak of the rebellion, Commander Rodgers was ordered to special duty at Cincinnati, Ohio, with General McClellan, to superintend the preparation of a gunboat fleet to operate in the western rivers. Three side-wheelers, the Conestoga, Tyler, and Lexington, which had been employed in freight and passenger traffic on the Ohio, were purchased, altered, and armed under his direction. Later, a fleet of ironclads was begun at St. Louis and elsewhere. The first three gunboats, the nucleus of the famous Mississippi flotilla, arrived at Cairo about the first of September. On the 23d of the same month, Rodgers was ordered to return to the east, and Commodore Foote took command of the naval force in the rivers, completing the work which Rodgers had successfully begun.

On the 17th of October, 1861, Rodgers was ordered to command the steamer Flag. To join his command he sailed as a passenger in the Wabash, Flag-Officer Dupont's flagship, when she left Hampton Roads on the 29th of October, to attack Port Royal. During the engagement of the 7th of November, Rodgers volunteered to act on the staff of the commander-in-chief. Of his services on that memorable day, Dupont says, "It would be difficult for me to enumerate the duties he performed, they were so numerous and various; and he

brought to them all an invincible energy and the highest order of professional knowledge and merit. I was glad to show my appreciation of his great services by allowing him the honor to hoist the first American flag on the rebellious soil of South Carolina."

After the battle of Port Royal, Rodgers took command of the Flag, and rendered efficient service in the subsequent operations along the coast, as long as he remained on the station. During the latter part of the time he had command of six gunboats, which were actively employed in surveying the intricate channels connecting with the Savannah river, in removing torpedoes and obstructions, and in supporting and co-operating with the land forces. He was not allowed to remain here long, however. On March 15, 1862, he was recalled; and a month later, April 21, he received command of the Galena, one of the new experimental ironclads, and joined the North Atlantic squadron.

About the middle of May, the Galena, accompanied by the Monitor and three other vessels, the Aroostook, Port Royal, and Naugatuck, was sent up the James river, under the command of Rodgers, to make, if possible, a passage to Richmond. At Drury's bluff, however, two separate barriers had been placed across the river, consisting of piles, steamboats, and sailing vessels. These were protected by the guns of Fort Darling, a heavy battery, and by sharpshooters in the rifle-pits that lined the banks. The latter made any attempt to remove the obstructions impossible, and could only be driven away by a land force.

The Galena ran within six hundred yards of the battery, as near the piles as it seemed proper to go, let go her anchor, and with a spring swung across the stream, whose width at this point was not more than double the length of the ship. The wooden vessels were anchored about thirteen hundred yards below. The Monitor was anchored near by. Indeed, at one time she passed above the Galena; but finding that her guns could not be sufficiently elevated for her fire to reach the battery, she dropped a little below.

The firing, which began at 7.45 on the morning of the 15th, lasted for three hours, with the ships in the same position. So long as our vessels kept up a rapid fire, the enemy rarely fired in return, but the the moment our fire slackened they remanned their guns. The fortifications mounted guns of the heaviest calibre, and their fire was remarkably well directed. The Galena was hotly engaged during the whole action, and she only brought it to an end when her ammu-

nition was exhausted. She had thirteen killed and eleven wounded, and she came out of the action covered with the marks of projectiles, and seriously injured. The fact was demonstrated that the Galena was not shot-proof. Thirteen shot and shell penetrated her side, splintering the armor, and many men were killed with fragments of her own iron.

After his gallant but unsuccessful attack on Fort Darling, Rodgers remained till November in command of the Galena, having meanwhile (July 16, 1862) been promoted to Captain. In November he was detached from the Galena, and ordered to command the Weehawken, one of the new monitors. Soon after leaving New York on her first cruise, the Weehawken encountered a severe gale, and doubts were entertained on board of her ability to keep the sea. The captain, however, refused to put into the Delaware, which was a near and safe refuge, and calmly answered all suggestions to that effect by saying that he was there to test the sea-going qualities of the new class of vessels.

In the attack on Fort Sumter, made on the 7th of April, 1863, by the fleet under Rear-Admiral Dupont, composed of the New Ironsides, the Keokuk, and seven monitors, Captain Rodgers was selected to head the line in the Weehawken. For two hours his vessel remained under the concentrated fire of a circle of heavy batteries, until the signal was given to withdraw from action. The attack, as is well known, was unsuccessful, owing to the failure of the squadron to pass the obstructions, and to the terrific fire to which the ships were exposed. More than half the vessels were wholly or partially disabled, and one of them, the Keokuk, sank the next day. The Weehawken was struck fifty-three times during the action.

Two months later, on the 17th of June, took place the memorable engagement between the Weehawken and Atlanta. The monitor Nahant was also present, but so rapid and complete was the result of the Weehawken's fire, that the other monitor did not have an opportunity to take part in the action. The Atlanta, or Fingal, formerly an English steamer, was a casemated vessel, with four inches of armor on her inclined sides. She was armed with two 6-inch and two 7-inch rifles. During the engagement, which lasted only fifteen minutes, the Weehawken fired five shots. Four shots struck the enemy's vessel. Of these the first broke in the armor and backing and disabled forty or more men; the second struck the edge of the overhang; the third knocked off the top of the pilot-house, wounding

two pilots and stunning the man at the wheel; and the fourth shattered a port-stopper. Upon this the Atlanta surrendered.

Rodgers's victory gained him the thanks of Congress and his promotion to Commodore. In his congratulatory letter, Secretary Welles recounted in the most cordial and emphatic terms the services Rodgers had rendered in the war. He said:

"Your early connection with the Mississippi flotilla, and your participation in the projection and construction of the first ironclads on the Western waters; your heroic conduct in the attack on Drury's bluff; the high moral courage that led you to put to sea in the Weehawken upon the approach of a violent storm, in order to test the seagoing qualities of these new craft, at the time when a safe anchorage was close under your lee; the brave and daring manner in which you, with your associates, pressed the ironclads under the concentrated fire of the batteries in Charleston harbor, and there tested and proved the endurance and resisting power of these vessels; and your crowning successful achievement in the capture of the Fingal, alias Atlanta, are all proofs of a skill and courage and devotion to the country and the cause of the Union, regardless of self, that cannot be permitted to pass unrewarded. To your heroic daring and persistent moral courage, beyond that of any other individual, is the country indebted for the development, under trying and varied circumstances on the ocean, under enormous batteries on land, and in successful rencontre with a formidable floating antagonist, of the capabilities and qualities of attack and resistance of the monitor class of vessels and their heavy armament. For these heroic and serviceable acts I have presented your name to the President, requesting him to recommend that Congress give you a vote of thanks, in order that you may be advanced to the grade of Commodore in the American Navy."

Rodgers was soon after detached, and assigned to the command of the Canonicus; but during the fall of the same year illness compelled him for a few months to abstain from active service. Early in November, however, he was again on duty—this time in command of the Dictator.

At the close of the war it was peculiarly fitting, in view of his important services in connection with the new ironclad vessels, that Commodore Rodgers should command the special squadron, to which the Monadnock was attached in her experimental voyage from Hampton Roads to San Francisco. It was upon this cruise, while lying at Valparaiso, that the Commodore showed, in the highest degree, that

prudence, judgment, and self-restraint which were among his leading characteristics. Active hostilities were in progress between Spain and the South American republics, and it was of the highest importance that no rash act of folly on the part of our naval commanders should embroil us with either party. Conscious of the strength of the squadron, and full of the confidence inspired by the successful termination of a prolonged war, our officers were ready and eager to take some part in the quarrel. Fortunately the commander-in-chief carried a head far too well balanced to be swayed merely by sentiments or inclinations. Of his conduct on this occasion Secretary Welles said: "The department had taken measures for reinforcing our squadron in the Pacific by sending thither a special force, consisting of the turreted ironclad Monadnock and the steamers Vanderbilt, Tuscarora and Powhatan, under the command of Commodore John Rodgers. This officer reached Valparaiso previous to the bombardment of that city, and, apprehending the views of the department, remained on that station for the protection of our countrymen until the arrival of Rear-Admiral Pearson. The appearance of so distinguished a commander, with a formidable squadron, on the eve of so important an occasion, and in the absence of Rear-Admiral Pearson, was opportune and fortunate.

"The course pursued by Commodore Rodgers in protecting American interests, and in observing and preserving neutrality in the harbor, met with approval. Whatever may have been his opinions or feelings as regards the course which the Spanish Admiral thought proper to pursue, he was not required to interpose his force against or for either party. As the armed representative of this government, which was on friendly terms with each of the belligerents, it became his duty, even while endeavoring to mitigate the harsh severities of war, to maintain a strict neutrality. His friendly offices in the cause of humanity were manifested so long as they could be effective; but the officers of other neutral powers having declined to unite in any decided steps to protect the city, no alternative remained for him to pursue, consistently with the position of this government towards the parties, than that which he adopted."

From 1866 to 1869 Commodore Rodgers was in command of the Boston Navy Yard. On the 31st of December of the latter year he was promoted to Rear-Admiral; and on the 5th of February, 1870, he was ordered to command the Asiatic station.

The government of the United States had decided that an effort

should be made to negotiate a treaty with Corea, to prevent a repetition of the barbarous outrages from which shipwrecked American seamen had suffered in that country. The known unfriendliness of the Corean authorities, and the unwillingness they had hitherto shown to enter into treaty relations with foreign powers, rendered it extremely doubtful whether the negotiations would result in anything, and made it necessary that our envoy should be backed by a considerable naval force. Accordingly, in the spring of 1871 the flagship Colorado, having on board Mr. Low, the American minister to China, proceeded to Corea, accompanied by the Alaska, Benicia, Monocacy, and Palos.

The fleet arrived at its anchorage in the Sale river late in May. Assurances were given of the friendly character of the expedition, and, with the assent of the native officials who visited the flagship, a surveying party was sent up the river in boats to explore the channel. After passing above the Corean forts the boats were treacherously attacked from the shore; and, as they were retreating with difficulty down the river, they received a severe though ill-directed fire from the forts.

The Admiral determined, in accordance with the general tenor of his instructions, that such an outrage should not be allowed to go unpunished; and after waiting ten days, to give the natives an opportunity to offer some explanation or apology, he landed a body of men to attack the forts. The arrangements for the landing and assault were admirably planned, and were carried out with judgment and success. Notwithstanding the difficulties of the undertaking, the five forts were captured and destroyed, and between two and three hundred Coreans were killed. The loss on the American side was trifling in numbers, amounting to only three killed and ten wounded; but among the former was the gallant McKee, who had been the first to enter the Corean citadel.

The fleet remained at its anchorage until early in July; and though circumstances rendered the conclusion of a treaty impossible, the Coreans had been taught a severe and much-needed lesson in the conduct of their relations with civilized powers.

On his return from the Asiatic station, in 1872, Admiral Rodgers was appointed President of the Naval Examining and Retiring Boards, a post which he retained for a year. He was then selected (June 15, 1873) to command the Navy Yard at Mare Island; and here he remained nearly four years, until April, 1877, when he was detached, and appointed Superintendent of the Naval Observatory.

The Admiral brought to this responsible position the progressive spirit, the perseverance, and the sound judgment that he had always shown to such a marked degree in the conduct of affairs. Surrounded by an able staff of scientific men, with whom rested the charge of carrying on the work of the Observatory, the superintendent was able to devote his energies to strengthening the establishment in its external administrative relations. His attention was early directed to the hygienic wants of the buildings, and his first care was to secure the funds for making them fit for habitation, which they could hardly be said to have been before. Finding that repairs were necessary which would fall little short of complete rebuilding, he seized the opportunity to bring to a decision the question of the removal of the Observatory to a healthier and more suitable site. After careful consultation with the professors and other competent advisers, he decided to recommend the purchase of the Barber place on Georgetown Heights. The history of his efforts, and of their final success, is well known. The first commission failed to agree upon a site, when the plan was devised of referring the question to a commission of experts. Their decision bore out the wisdom of the Admiral's choice; and the Observatory, by his untiring efforts, secured an unequalled site and the certainty of a material reconstruction.

From the time of his appointment to the superintendency of the Observatory until his death, the Admiral's services were constantly in requisition upon various special boards, to all of which he brought the same intelligence and ability, the same sturdy good sense, that he had shown in his earlier duties. Among other positions which he held, he was selected as the president of the Transit of Venus Commission, whose object is the solution of the greatest problem that now claims the attention of astronomers. But of especial importance were his services on the Naval Advisory Board, whose duties were by far the most noteworthy that have been entrusted to a board of naval officers since the war. Rodgers was appointed president of this board, June 29, 1881. Notwithstanding the multiplicity of interests that fell within his charge at the same time, he was far from being content with the merely formal duties of a presiding officer. He took an active part in the deliberations of the board, and he impressed them with the stamp of his vigorous personality. No voice was heard more frequently in debate, and none exerted a more direct and powerful influence.

He took an equally important part in the work of the Jeannette

Relief Board, of which he was also president. He was the only member of that board who had been over the ground. To him was due all the knowledge that we possessed at the time of those unfrequented waters. His work in the Vincennes had fitted him, as no other man in the service had been fitted, to determine the measures and methods which would promote the object of the relief expedition; and, accordingly, at the meetings of the board, he was not only the president, but the foremost member.

During all this period of duty in Washington, in addition to his active work at the Observatory, and in addition to all the temporary duties upon boards, some of them of considerable duration, which were imposed upon him, Admiral Rodgers served as the efficient and unwearied Chairman of the Light-house Board. Appointed a member on May 1, 1878, two weeks after being ordered to the Observatory, he was elected Chairman of the Board on the 23d of June following. His services in this capacity are best described in the official announcement made by the Secretary of the Treasury, upon the occasion of his death, who says: "The board has received valuable aid from his sage advice and his constant counsel. Notwithstanding his great age and consequent infirmities, and the pressure of his other many duties, the Admiral has visited many light-stations, and has personally superintended and taken part in numerous experiments, many in acoustics and optics, conducted on the sea or in the laboratory, and has so impressed his individuality on the service that his name will live with it, and add lustre to its repute in the future"

The last illness of Admiral Rodgers found him still in the full current of professional labor. It would have seemed but just that, after fifty-four years of unremitting effort, this noble life should not have passed away without at least a brief period of that repose which had been so richly earned. But it was ordered otherwise. The disease by which he was attacked in the winter of 1881-82 gradually assumed a fatal character, and all that could be done was to alleviate, as far as possible, the sufferings of the last hours. Late in April, the Admiral was removed to the Barber mansion, on Georgetown Heights; and there, on the site of the national observatory of the future, the erection of which had been his cherished hope, he passed peacefully away, on the 5th of May, 1882, at the ripe age of threescore and ten.

Admiral Rodgers was singularly fortunate in preserving unimpaired his vigor of mind and body, down to the approach of his last

fatal illness. Many men, originally alert and vigorous, undergo, through the wear and tear of an active naval career, a sort of mental or physical exhaustion which modifies essentially their line of thought or of action. The Admiral was an exception. Though he matured early, he retained his powers to the end. He was never satisfied with retrospects; and a ripe age found him thinking as wisely and acting as resolutely as he had done years before. He was once heard to remark upon the growing unwillingness to take responsibility that comes with advancing years. But, however he may have felt this, he did not show it in the conduct of affairs. He never lost his faculty of initiative; and he never shrank from taking the steps that such a faculty imposes. His mind had always been essentially reflective. He thought out a subject with patience and care; but when the emergency required, he was ready to act. He was never slow, but always thorough; and he had the rare temperament, so desirable in a naval officer, which made him open to argument in discussion, but persistent and tenacious in action. Deliberate in maturing a plan, his conception was always bold, and his execution rapid and unerring.

The elements of the Admiral's success in his professional career lay neither in good fortune, nor in the influence at his command. He was a fortunate man; but his success was due less to fortune than to his ability and eagerness to seize every opportunity for professional activity that fortune threw in his way. Influence he certainly possessed; but his influence was simply the legitimate result of his personal character, and of his ability to bring others into accord with his judgment. Without doubt he was ambitious; but his ambition consisted in the indestructible desire to do well everything that he was called upon to do. Upon whatever work he was engaged, no matter what might be its extent or importance, he could never be content with doing less than his best. The same lofty purpose and the same careful judgment were applied to all he did, small things as well as great. Personal motives had no weight with him. He never struggled for place or for power, but both came to him unsought. Devoted with ardor to his profession, he was thus enabled to rise above the petty spirit of cliques and coteries; and he was never in the smallest degree the object of professional jealousy or mistrust. No man of his high character and just discernment could be free from likes and dislikes; but no man ever took more care to avoid injuring by word or deed those who failed to win his esteem or regard. Free

from malice and prejudice, calm and dispassionate in judgment, even in temper, and kindly and amiable in manner, the Admiral was a man who kept himself with little effort on good terms with all the world. But the trait in his character which perhaps struck most forcibly those with whom he came in contact was his absolute straightforwardness. He was a man utterly without subterfuge or reservation,—a man whom you could not but feel at once that you must trust. It is therefore hardly to be wondered at that, down to the time of his death, no man in the service commanded more universal respect and regard than John Rodgers; and none have died more universally regretted.

The Admiral's private character was as admirable as that by which the world knew him. Perhaps this is hardly the place to touch, even lightly, the veil that surrounds the inner life of a man's own hearth and home. Yet it would be hard to close even this brief memorial without one word for the thoughtful care, the loyalty and devotion, the loving tenderness, which brought peace and happiness upon that household, through the long and busy years of a well-spent life.

NAVAL INSTITUTE—BOSTON BRANCH,

FEBRUARY 28, 1882.

COMMANDER O. A. BATCHELLER, U. S. N., in the Chair.

DISCUSSION:

THE USE OF IRON AND STEEL IN THE CONSTRUCTION OF VESSELS OF WAR.

LIEUT. J. C. SOLEY.—As the duty has been assigned to me of opening this discussion, on the merits of the two metals, I shall endeavor to point out some of the features which demand consideration, as bearing more particularly on their availability for vessels of war, to which especial reference is made in the subject assigned. The same considerations, however, will apply to the vessels built for the great transatlantic lines, which, according to the popular idea, should in the event of war be available for the naval needs of the power to which they belong; and the experience of the lines is so much greater than our own that I hope we may obtain some useful lessons from their practice.

Long ago it was found by private firms that vessels, to meet the requirements of the present day, could not be built of wood, and iron was substituted, till now a wooden ocean steamer is a rare sight. The demand for iron brought its manufacture to a high state of perfection, but no sooner is this perfection reached than we find builders not satisfied with iron, and now steamers are being built of steel. Nearly all of us have read a report which was lately published on the Servia, a new vessel of the Cunard line, where steel is used wherever it can possibly be done. Now our 5000-ton ships must be able to do just such work as the Servia can do, and if iron will not do for a Cunarder it will not do for us.

I have here some figures which will enable us to compare the relative merits of the two metals. An iron ship was built, and at the same time all corresponding pieces of sizes required by Lloyd's measurement in steel were weighed, with this result:*

	Iron.	Steel.
Total weight equipped, in tons	1740	1614
Dead weight carried on twenty-two feet mean draught, in tons	3235	3361
Gross weight of plates	799	713
Total iron or steel in hull	1179	1053
Draught in ballast	10′8″	10′2″
Total cost	£10,395	£13,056

* These figures were kindly furnished by Naval Constructor W. L. Mintonye, U. S. N.

Another example can be found in the Iris, a dispatch vessel lately built for the British navy to make the greatest possible speed, which is built of steel and weighs 3900 tons. In this ship there is a gain of 185 tons dead weight by building of steel instead of iron.

It has been a favorite argument of those who are opposed to the use of steel, that we could not produce steel in this country which would be suitable for building vessels. I have so much confidence in the ability of our manufacturers as to believe that they can furnish it when there is a demand for it. But in the census table just published, showing the world's production of pig iron and steel, the United States appears second in the list of countries. Great Britain stands first, Germany third, and France fourth. In 1880 we produced only about half as much iron as Great Britain, but we turned out more Bessemer steel, and but little less of all kinds of steel than is placed to the credit of that country. In round numbers the British yield was 7,750,000 tons of iron, 1,044,000 of Bessemer, and 1,415,000 of all kinds of steel; while the American production reached 3,835,000 tons of iron, 1,074,000 of Bessemer, and 1,247,000 of all kinds of steel. The world's production in 1880 is given at 17,688,000 gross tons of iron and 4,343,000 of steel. Of these amounts the United States produced twenty-two per cent. of iron and twenty-nine per cent. of steel. Every year the proportion in our favor becomes greater, and when the manufacturers see a certain demand before them they will be able to meet it. The production of steel requires experience and expensive plant. The certainty of demand will justify manufacturers in investing in new plant which they would otherwise hesitate to do.

I propose now to consider the requirements of the material of which ships may be built, and to see whether steel or iron will best meet them. Some of them are strength, resistance to vibration, rigidity, buoyancy, fouling and oxidation, resistance to penetration, effect on compasses.

Strength is the first in importance, because, in addition to carrying very heavy weights, the necessary speed can only be insured by powerful machinery, which involves perfect rigidity in the hull, and because the ship must be able to withstand a tremendous pounding from the sea when driven at full speed in heavy weather. In this respect there can be but little question between the metals, for the tensile strength of iron plates is about 65,000 lbs. to the square inch, while that of steel goes as high as 120,000. Moreover, wrought iron, on being subjected to frequent vibration, loses its fibrous nature, which is its whole strength, and becomes gradually crystalline, the rate of change being in direct ratio to the rapidity and force of the vibrations; steel, on the contrary, undergoes no such change, but maintains its normal character, subject to degradation from the same cause, it is true, but much slower in its action and requiring powerful motive force.

Rigidity is the next in importance, because the machinery, which is the motive power, requires for its perfect action a bed so immovable that no shocks can change its figure enough to interfere with a piece of mechanism whose perfect working depends on its trueness. Therefore, anything like permanent change of figure, however small, must be avoided. The tensile strength per

square inch for the limit of elasticity is, in iron, 21,000 lbs.; in steel, 93,000 lbs.; while the ratio of this strain to that causing rupture is as 26 to 62. The small amount of elasticity in the wrought iron, as compared with its great ductility, is a positive source of weakness, while the steel will resist a permanent set under a greater strain than will produce rupture in the iron.

Buoyancy is the next point, because heavy weights must be carried, if possible, on a nearly stable platform, and the guns must be in condition for being worked at any time. The figures which I have already given will, I think, show conclusively that the same strength and displacement can be secured in the steel as in the iron vessel, with a great increase in weight carried by the steel vessel. This saving in weight can be put into coal, which is a serious consideration in vessels which burn such large quantities, and, in addition, although steel costs so much more than iron, so much less weight is required that the difference in the cost is not material.

Fouling on the outside and oxidation on the inside are sources of serious trouble both in steel and iron ships. Fouling is the immediate result of oxidation on the outside, for there is nothing to which grass or shell-fish can attach themselves until the surface has been roughened by corrosion. Corrosion is a sort of slow combustion, during which the iron combines with oxygen and forms rust. Warm sea-water hastens the corrosion, and, consequently, in tropical climates fouling is a great objection to an iron bottom. This objection, however, applies equally to iron and steel, or if there is any difference I am not prepared to say what it is, but it can be prevented either by frequent cleaning and painting or by wood sheathing.

But on the inside of the vessel oxidation is a more serious matter, particularly in the bilges. Corrosion is more rapid when the metal is partly wet and partly dry than when wholly immersed or when wholly exposed; it is accelerated by the presence of decomposing organic matter, of pure acids, or of matter electro-negative to iron, such as copper or iron rust. But in this connection it is important to notice how the action takes place in the two metals. I have had prepared these two blocks, one of iron and the other of steel. They were as nearly as possible of the same size at first, and they have been immersed in a bath of hydrochloric acid for about a week. It will be seen that the iron is eaten away deep below the surface between the fibres, while the action on the steel has been much slower and entirely superficial. The presence of oil in the bilges of steamers, with the possibility of a copper bolt sometimes finding its way down, makes the oxidation a great source of weakness, but I do not think there can be any question as to the merits of the two in this respect, though it can be prevented in both by covering the bottom inside with cement.

Although the question of armor does not properly come within the scope of the subject, it deserves mention as an additional argument in favor of steel. The experiments made by the Italian government at Spezia are sufficiently fresh in our minds for us to recall what a complete revolution they made in the whole question of armor, proving conclusively that much greater resistance could be obtained with steel-faced plates, while there was a great saving in weight.

It is a well-known fact that the magnetism of an iron ship has a great effect on the compasses, causing great deviations, which are a source of anxiety and danger. There are two principal kinds, quadrantal and semicircular deviation. The quadrantal deviation, depending on the soft horizontal iron, will not be much affected if the ship be of iron or steel, as it depends on the induction at the time being.

The semicircular deviation is the most important consideration, and its principal factor in an iron ship is the sub-permanent magnetism. The steel or iron of which a ship may be built is subject to so many blows that it becomes a magnet, but the steel makes a more perfect magnet than the iron, and retains its magnetism longer, so that, although the semicircular deviation will be greater in a steel ship than in an iron one, the sub-permanent magnetism becomes more nearly permanent, and the deviation a constant quantity, and therefore more easily compensated.

CHIEF ENGINEER E. D. ROBIE.—In commencing any discussion of the relative value of iron and steel for shipbuilding purposes, it is important to first define as exactly as possible what grades of these materials are to be considered.

In such an important structure as a naval ship, where the failure of a single plate may cause the loss of hundreds of lives, or decide the issue of a great battle, every one will readily concede that the best quality of each material is the only grade worthy of our consideration.

The high grades of iron of the best quality for steam boiler plates, rolled in the United States, possess most of the good qualities claimed for the mild steel in Europe, and compare favorably in tensile strength and ductility with that steel.

Now, unless we can make a definite distinction between the best United States iron and European mild steel, all the arguments in favor of that steel will of course apply with equal force to our best iron; but if we confine the discussion to the relative value of the best quality of our own iron and our own mild steel, of still greater tensile strength, ductility and homogeneity, we will have to consider as most important their relative cost and durability.

First, however, it will be well for us to consider what grades of iron and steel are now being used in Europe.

The tests of the British Admiralty for the best boiler plates of iron require them to possess an ultimate tensile strength, per square inch of section, of twenty-one tons lengthwise and eighteen tons crosswise of the grain.

The tests of the steel plates used in the boilers of the Imperial Russian yacht "Livadia" proved them to have a tensile strength varying between 26.1 and 28.3 tons per square inch, and to have about equal strength in any direction.

This practically equal strength in any direction is one of the great advantages possessed by steel over ordinary iron plates. Unless the iron blooms are worked so much as to make the plates rolled from them cost fully as much as steel, they usually prove much weaker when strained to fracture across the fibre than in the opposite direction, while the steel which is rolled from a cast ingot with comparatively a small amount of work on it has much greater homogeneity of structure.

This also facilitates the flanging or bending of steel plates in any direction without the liability to rupture which iron plates exhibit when we attempt to turn a flange or bend them in the direction of their fibre.

The tests for steel plates for ships building in the British Navy require them to have a tensile strength of not less than twenty-six tons, or more than thirty tons per square inch in any direction, with a minimum elongation of twenty per cent. in a length of eight inches.

At Pittsburg, Pa., in the fall of 1878, I witnessed the manufacture of 126 plates of C. H. No. 1 flange iron at the Sligo Iron Mills, by Messrs. Phillips, Nimick & Co. Every one of those plates I tested to determine their tensile strength and elongation.

The result of those tests in a tabular form marked A, I will append to this paper. Not a single one of those 126 plates of iron, $\frac{7}{16}$ of an inch thick, was fractured with less than 64,000 pounds tensile strain per square inch of section; thirty of them had an ultimate tensile strength between 65,000 and 70,000 pounds; seventy-four of them ranged between 70,000 and 75,000 pounds, and the remaining twenty-one plates had an ultimate tensile strength between 75,000 and 80,000 pounds per square inch of section. The average tensile strength of 114 of these plates in the direction of the fibre was 72,109 pounds, and the remaining twelve plates which were tested across the fibre averaged 71,786 pounds, but the percentage of elongation in these was only about one-half that of the others, although their tensile strength was practically the same. The maximum percentage of elongation with the fibre was twenty-five, and across the fibre the minimum was 12.5 per cent.

Comparing these tests, it becomes evident that such iron plates are superior in tensile strength to the steel plates required for ships by the British Admiralty.

Such facts as these may account for the radical difference of opinion expressed by engineers and constructors of great ability in regard to the best material.

The report of the majority of the Naval Advisory Board stated that "the most difficult question brought before the Board for its decision has been that of the proper material of construction for the hulls of the vessels of the larger classes."

At first they decided to recommend iron, but finally reported in favor of steel, for reasons which they considered conclusive.

In the report of the minority of the same Board, they state that "we recommend iron instead of steel, and we do this after a careful comparison of the merits of the two."

They remark upon the great difference in quality between the British and United States iron, and speak of the greatly increased cost of the so-called steel if it were to be manufactured in this country, and also say that, "as the mild steel is much more corrodible than the iron, an additional thickness must be given to it in order that it may have equal durability in the hull."

They also state that the workmanship on steel is greatly more difficult and costly.

In Europe the same radical difference of opinion in regard to the relative value of iron and steel for shipbuilding still exists among excellent authorities; and in the French Navy the use of steel for the external plating of ships has been prohibited on account of its alleged more rapid corrosion. It seems probable that this difference in opinion is caused by the different qualities of iron and steel which these authorities have experimented with.

In the *Journal of the Iron and Steel Institute* for 1881 there are some excellent papers on the subject we are considering, from which I will quote a few points of especial interest.

At the annual meeting of the Institute last May, Mr. Menelaus was presented with the Bessemer medal for 1881, and in the course of his remarks said that as steel rails were already made as cheaply as iron rails, he believed that before long the steelmaker would be able to offer steel for building ships which would be as cheap as iron, while it was infinitely better and stronger, and he expected to see the use of iron completely abandoned for building ships.

The President of the Institute said in his address that the manufacture of steel had been recently increased a thousand-fold, and "it appears probable that the present system of manipulating crude iron in order to adapt it to all manufacturing purposes will ere long be greatly changed, so as to follow, in some modified form, the existing mode of producing ingot metal"; and that he expects the importation of expensive ores will cease as soon as a recently invented process is perfected which makes steel of a very fine quality from iron rich in sulphur and phosphorus. He speaks of the fact that there are now nearly 120,000 tons of steel shipping known to be under construction in the United Kingdom, notwithstanding the difference in cost that still exists between steel and iron plates, and says that steel, with its greater strength and a difference of 20 per cent. in weight in its favor, must be a formidable rival of iron; and finally, that "the use of steel is now increasing gradually but surely in naval construction both at home and abroad."

Mr. Wm. Denny, of Dumbarton, who has had very extensive practical experience on the subject, read a paper before the Institute "On the Economical Advantages of Steel Shipbuilding." He states that his experience gives a saving of 13½ per cent. upon the weight of the iron when using steel. He gives an example of a high-speed passenger steamer, and says, "This is a conclusive proof that even at the present prices it is advantageous to build such a class of steamers of steel. That this argument is appreciated by the great steamship companies is proved, in the case of the London and Calcutta trade, by the fact that all the latest orders of the Peninsular and Oriental Steam Navigation Company and the British India Company have been for steel vessels." Mr. Denny concludes his instructive paper as follows: "Regarding steel there has been only one doubt raised this year, and that is as to its corrosion. Theoretically there may seem cause to dread such corrosion, but the history of steel ships, up to this date, affords little ground for the opinion. Of the steel vessels built by my firm, only one has been reported as in any way showing even a symptom of corrosion. That this was purely exceptional is shown by the fact that several other steamers of the same mate-

rial have been running in the same waters with the most satisfactory results, no more mention of corrosion being made even in the case of the original steamer."

This important subject of relative corrosion has been ably treated by Mr. Parker, the Chief Engineer, Surveyor of Lloyd's Register, London. He criticizes the conclusions of the late Admiralty Boiler Committee and Mr. Mallett, and says they do not accord with experience, and, after detailing his own extensive experiments, concludes that steel boilers or steel ships are not likely to corrode to any serious extent more than iron.

In the discussion of these papers by members of the Institute, examples were cited of steel boilers which had been in use over twenty years, in which there was no corrosion at all.

Mr. Henry Bessemer described some steel boilers which had been at work for twenty-two years and still showed no signs of corrosion, and he expressed the opinion that such evidence was convincing proof of the fact that the corrosion of steel was no more than that of iron.

All the speakers agreed that mild steel did not corrode to any serious extent more than iron under similar circumstances.

In my own experience in this navy yard one of the dry dock iron boilers has been recently condemned as unfit for use on account of extensive corrosion after less than fifteen years' service, and I have also examined a great number of iron boilers in naval ships which I have found were entirely ruined by corrosion in less than half that time.

The question of the relative corrosion of iron and steel plates, under similar circumstances, has been discussed before the British Institution of Naval Architects, by members of the greatest experience, and it will be of interest to select some of the leading points made by them for our information.

Mr. Denny described an extraordinary case of corrosion which occurred in the steel screw steamer "Ravenna," built for the P. & O. Company. This vessel was built entirely of steel and riveted with steel, but the stern frame and rudder frame were of forged scrap iron. After about a year's service he found the skin of the vessel entirely free from corrosion, but very serious pitting on the iron rudder frame under the first rudder band extending to over three-sixteenths of an inch in depth, and that, in certain thin iron plates used about the rudder, there had also been corrosion, but the large plates of steel on the rudder were not corroded a particle, and he concludes it is rather a dangerous thing to mix up ordinary iron with steel.

Mr. Samuda's evidence in regard to corrosion is also particularly valuable on account of his extensive experience. He says, "We do not expose steel to corrosion in the hulls of our ships, because if we do we expose it to unnecessary destruction. If the material is properly prepared, coated and painted, you have security against corrosion." He continued, "I recollect perfectly in the early stages of steel shipbuilding that two ships were sent out on the same service. One pitted so violently that it was incapable of being used within three or four months, and the other worked successfully for years, and I believe the whole difference to have been that, in the case of the suc-

cessful vessel, the steel had first been allowed to rust so as to separate the hard scale, which is always produced in the rolling of steel, and which, if painted on, tends more than anything else to produce the pitting, by allowing the water to get between the paint and the real skin of the steel. If that, after having been allowed to corrode, is struck off carefully, and the paint is put on the solid steel, you have that solid surface to depend upon."

Mr. Martell mentioned a case where a steel vessel with iron rivets gave evidence of corrosion of the steel while the iron rivets were perfectly sound; "but," he said, "no doubt, if the steel had been properly protected with paint or otherwise, there would have been no corrosion, as it did not extend any during the subsequent year."

A paper was read by M. Fontaine, who is possibly the best authority in France, "On the Use of Mild Steel for the Construction of the Hulls of Ships in the Arsenals of the French Navy." The relative corrosion he stated to be the only reason which still exists for continuing the use of iron in the exterior plating of the hull.

"There is evidence," he said, "that steel plates in sea water rust more quickly than iron plates under similar circumstances." He cited the "Tromblon" as an example. This vessel had to be docked three times in nine months to paint the hull, as the steel plates were so rapidly corroded, especially near the water-line, and in the French navy they had refused to substitute steel for iron in the external plating on account of this rapid corrosion, and they also still use iron rivets of the best quality instead of steel.

In the discussion by members of the Institution of Naval Architects, which followed, Dr. Siemens contended that the steel used by the French navy was not properly made, or there would have been no trouble from corrosion, and also the fact of their using iron rivets in steel plates had a bad influence. He cited experiments continuing for years where steel was less corroded than iron. Mr. Riley endorsed his remarks and had found no increase of corrosion in steel plates.

The general result of the evidence adduced was that, when the steel was made from ore and pig metal without the use of any scrap iron, and the riveting was done with steel rivets of the same quality, there is no more corrosion with steel plates than with iron.

In the annual address for 1881, of the President of the British Institution of Naval Architects, he mentions, as a great event of the past year, the great progress and the immense development of steel manufacture and its increased application to shipbuilding.

He speaks of the then unprecedented feat of the Arizona in crossing the Atlantic in seven days and eight hours, and continues, "Now, there are two lessons to be derived from that: one is that high pressure is not a source of danger, and that steel is a great safety to life, and also that steel is a most invaluable material for shipbuilding purposes, combining, as it does, strength with lightness and great elasticity. It has been said by eminent authorities, and I am rather disposed to agree with them, that the days of iron for shipbuilding are numbered."

The expression of this opinion in his annual address by such an authority as the President of the British Institution of Naval Architects must be considered as excellent evidence that steel is to take the place of iron in the best shipbuilding.

The Vice-President of the same institution, at the same meeting, read his paper on the "Almirante Brown," Argentine armored corvette, and the effect of steel hulls and steel-faced armor on future war-ships.

Some of the most interesting points in his paper on the subject we are considering I will quote.

He says, "The Almirante Brown, I believe, is the first vessel afloat which has been constructed entirely of steel and coated with steel-faced armor, and I believe a reference to her guns carried, the armor resisting-power attained, and the great capability of steaming without recoaling, will show advantages beyond those possessed by any previous vessel of similar tonnage and power; results mainly due to the material employed in the construction of hull and armor. This is a vessel of moderate size—4200 tons displacement, combining all the latest improvements in construction, armor, and armament. The hull is built entirely of Siemens steel; the armor is compound, or steel-faced, nine inches thick, which is found in practice to be equal, in shot resistance, to iron armor twelve inches thick.

"The effect of substituting steel for iron in the hull and steel-faced armor for iron armor has been to obtain the same strength and resistance to shot that could only have been obtained in an iron vessel of similar size and strength with 510 tons additional material; and when increased in dimensions to meet this, 350 tons more would be needed for the extra weight due to the enlarged hull.

"An iron built and armored vessel constructed to carry this additional weight, and of such extra dimensions as would be necessary if the same speed were to be maintained with the same draught of water and coal-carrying capacity, would have to be increased in size, displacement and power as follows: The length of the iron ship would be 260 feet and beam 55 feet, against 240 feet length and 50 feet beam in the steel ship. The displacement of the iron vessel would be 5200 tons, and power required 5000 horses; against a displacement of 4200 tons, with 4500 horses' power in the steel vessel. In other words, it would involve 1000 tons more displacement and 500 additional horses' power for the iron vessel to possess equal speed and shot-resisting power. The iron vessel would also be obliged to carry seventy tons more coal to steam an equal distance.

"The increase of the material is arrived at from adopting one-quarter extra thickness in iron in the hull beyond that used for steel, which barely gives an equivalent strength, and one-third more weight in the armor than that used for the steel-faced armor, which gives the iron armor the same resisting power as the steel-faced; and the one thousand extra tons' displacement is the unavoidable result of carrying this increased weight of hull, armor, engines and coal with equally good lines on a similar draught of water and with the increased power required for driving the larger ship at the same rate and over the same distance."

He then says, "I know that some doubts have been expressed as to the equal reliability of steel structures to those of iron, but I must say that my experience, reaching over many years, does not sustain any such doubt.

"I have found steel, especially the Siemens-Martin steel, in all respects a superior metal to iron. It possesses one-third more tensile strength; much more ductile, both hot and cold; can be efficiently worked cold in most cases where iron must be worked hot, and when properly prepared and annealed where necessary and coated with proper paint, it has in no instance given any symptoms of unreliability or of premature decay.

"The profession is greatly indebted to the present Director of Naval Construction of the British Navy, Mr. Barnaby and his staff, for advancing the practical application of steel in the highest degree.

"The very fast cruisers, Iris and Mercury, and the six sloops of the 'Comus' class, are most important and successful instances of the usefulness of steel; and the Conqueror, Colossus, Majestic and Polyphemus are being built not only of steel, but with the intention of using compound or steel-faced armor, as in the 'Almirante Brown.'"

He concludes by saying, "I regard with no small satisfaction the confidence shown by such authorities, and the effect it must have in shortening the time necessary to produce a general, if not universal, appreciation of the advantages to be derived from the use of steel instead of iron in structures of all descriptions."

In regard to the comparative facility of working steel, Dr. Siemens states that mild steel should bear any amount of rough work in the cold state without receiving the least injury. He says, "If by punching mild steel the strength is lost, that is clear proof that the material is not of good quality. So far from losing strength, the very act of punching increases the strength of the material. In fact any treatment to which mild steel is subjected, straightening it, or punching it, or squeezing it in any place so as to alter slightly its form, invariably increases its strength, and not slightly either; and therefore I have little sympathy with the practice of annealing plates after punching. If it is a proper metal it should not require it.

"There is great danger in annealing steel plates. If the plate has been partially heated in order to bend it, then annealing is necessary to put it as a whole in a natural condition, but if the metal has been worked cold I believe it would be much better without being annealed."

In M. Fontaine's valuable paper on the use of steel in the French Navy, he gives an account of the friendly rivalry between the French and English steelmakers, with the rapid progress in quantity and steady improvement in quality of the mild steel plates made both by the Siemens-Martin and Bessemer processes, until now they all obtain, with certainty, steel that satisfies all the conditions for acceptance imposed upon them by the Admiralty, and several manufacturers employ both processes simultaneously.

He enlarges on the necessity of working the steel only while hot, instead of allowing it to be worked after it has cooled down below a dull red, and shows that the workmen manage it equally as well as iron after a little experience;

and recommends the use of wooden mallets and swages when possible instead of iron. He describes the ease and certainty with which steel plates are now welded, equal in every respect to that of similar pieces of iron, without the use of any special process or particular flux.

One of the most important points made by this writer is in regard to the saving of weight in a hull of given dimensions by the use of steel instead of iron, which is estimated at twenty-five per cent., but the authorities of Lloyd's Register think it is not safe to reckon on a final saving of more than twenty per cent.

In regard to the relative cost, the examples quoted by Mr. West show clearly that the actual cost of a steel ship three years ago was greater than that of an iron ship of the same external dimensions in proportion of nine to eight. M. Fontaine then remarks: "For the French Navy, which uses exclusively iron of the best quality, the time has already come at which the hull of a steel ship comes out at a lower price than the hull of a ship of similar dimensions built of the best iron."

Taking the first-class ironclad Foudrayant as an example, he calculates that the substitution of steel for iron in all parts of the construction would effect a saving in weight of twenty per cent., and in cost of 12.4 per cent.

Chief Constructor White of the British Admiralty states that already in the government service they can get steel cheaper than the high class iron they wish to have, which has to undergo rigorous tests. And speaking of the cost of labor, he said: "That a ship of given bulk and form would cost about the same if built in steel as in iron, the steel ship being so much lighter."

A careful comparison of the cost of steel vessels in the United States shows that they can be built here for about twenty per cent. more than iron vessels of similar dimensions, and as their displacement would be at least twenty per cent. less, that great difference is available for carrying coal, machinery and ordnance.

Mr. Park, of Pittsburg, estimates that the steel plate rolling mills in this country can supply an average of 100 tons of steel plates per day.

Here in Boston, the Norway Iron Works are now casting about 1300 tons of steel ingots per month, and the Bay State Iron Works are rolling about 300 tons of steel plates per month.

During the past year over a million tons of steel rails were rolled in the United States, and there seems to be no doubt that we can obtain all the steel plates required for our ships in our own country.

In a recent work on Steam Boilers, by Engineer-in-Chief W. H. Shock, U. S. N., there is a chapter on "Materials," which explains their relative value and various qualities in a complete and concise manner. In regard to steel, the author remarks that "the milder kinds of steel possess all the good qualities of wrought-iron, only in a higher degree, and differ from it principally by their greater purity and their perfectly homogeneous structure." Another chapter on "Testing the Materials," in the same work, is very valuable, and gives a full account of all the various tests prescribed for iron and steel by the United States, English and French governments.

Chief Engineer J. W. King, U. S. N., in his celebrated book on "The War Ships and Navies of the World," has ably explained, in a clear and concise manner, the value of steel as a material for war-ships. He concludes that "all things considered, it is highly probable that steel will, at no distant time, have almost entire possession of the field as a shipbuilding material, and now that its claims are finally recognized, will supersede iron as rapidly as that material has taken the place of wood."

Finally, I will quote for the benefit of the Naval Institute part of a valuable letter I have recently received from Mr. Gibbons, the eminent Director of the Pusey and Jones Co.'s great shipbuilding works at Wilmington, Del.

He says: "That at this day there should be those who doubt the relative superiority of steel plates over iron, for any of the many purposes for which iron plates have been used in the past, is only an evidence of their want of practical acquaintance with the subject.

"Answering the question as to why they are superior, it is only necessary to state that steel possesses greater ductility than iron; is less brittle; is, by reason of its production from melted ingots, homogeneous and free from laminations, and can be bent and twisted in any desired form without risk of breaking. It may be replied to this that the *best* grades of iron plates will do all that is claimed above, and if we select 'Lowmoor' or 'Sligo,' or one or two other brands of iron, this is true. But these are the exceptions. Iron of these grades is seldom or never used in common work, and never, so far as I know, in hulls of vessels; while the rule is that *all* steel will do the work as above safely.

"An analysis of either 'Lowmoor' iron or 'Sligo' and Siemens-Martin steel would show them practically to be the same thing—hence their similarity in practical work.

"I enclose a piece of paper folded double. A piece of steel plating may be so treated without any signs of fracture, and possibly Lowmoor iron would do the same, but hardly any others, while almost any piece of steel plate you will chance to find will endure this hard test without any sign of fracture. Of course the bending should be while cold, and the plate crushed down under a steam hammer.

"So much for steel and the best grades of boiler iron. In the grades of iron used in the hulls of iron vessels, I never saw a piece in my life that would turn a right angle without signs of fracture, and very much of it will not bear bending forty-five degrees.

"My company have built ten hulls of vessels of steel, and I have had abundant opportunity to watch it in all its working, and then to follow the vessels into their hard service; and when I saw them withstand a class of work that I am sure no iron vessel would live under, and, except the indentations upon their hulls from contact with snags and rocks, seemingly as good as ever, I am naturally a hard subject to convince that steel is not the best material for hulls of vessels."

Such an array of evidence in favor of steel must be conclusive. The iron age has passed away—the steel age has now fairly commenced. The impetus which our government will give to the steel manufacture in our own country,

by using that material in the construction of our new naval ships, will so greatly cheapen its ultimate cost as to extend its use to all vessels, and result finally in these United States becoming the leading shipbuilding country in the whole world.

TESTS OF "C. H. NO. 1 FLANGE" IRON, MADE BY CHIEF ENGINEER E. D. ROBIE, U. S. N., FOR MESSRS. PAULDING, KEMBLE & CO., COLD SPRING, N. Y., SEPTEMBER, 1878.

Number.	Breaking Weight per sq. in.	Elongation, per cent. of Length.	Number.	Breaking Weight per sq. in.	Elongation, per cent. of Length.	Number.	Breaking Weight per sq. in.	Elongation, per cent. of Length.
1	74,929	.25	43	68,571	.20	85	73,152	.19
2	72,016	.19	44	70,423	.19	86*	75,600	.12½
3	78,055	.25	45	71,657	.19	87	70,857	.25
4	71,606	.25	46	72,000	.21	88	72,228	.19
5	74,338	.19	47	75,988	.20	89	70,903	.20
6	74,765	.15	48	74,023	.21	90	73,846	.19
7	73,845	.19	49	76,336	.15	91	72,685	.19
8	75,888	.22	50	67,520	.21	92	74,285	.19
9	75,029	.25	51	73,371	.23	93	77,511	.21
10	75,314	.12½	52	75,312	.20	94	73,920	.20
11	75,645	.25	53	73,817	.21	95	74,388	.19
12	72,091	.19	54	75,425	.12½	96	74,992	.19
13	70,352	.22	55	72,377	.21	97	71,383	.19
14	73,845	.23	56	71,488	.23	98	75,977	.20
15	70,288	.22	57	74,976		99*	74,057	.12½
16	75,475	.20	58	71,611	.24	100	72,685	.19
17	69,728	.24	59	69,348	.21	101	74,950	.19
18	74,095	.20	60	71,360	.20	102	73,028	.21
19	75,075	.21	61*	72,685	.12½	103	76,112	.15
20	74,175	.20	62*	70,317	.12½	104	71,863	.19
21	71,945	.21	63	79,744	.19	105	77,712	.12½
22	71,110	.20	64	68,978	.19	106	71,931	.19
23	72,320	.20	65	71,143	.22	107	72,250	.15
24*	68,570	.15	66	71,200	.20	108	73,152	.21
25	72,336	.19	67*	74,511	.12½	109	67,588	.21
26	67,328	.12½	68	73,136	.24	110	68,570	.21
27	68,114	.15	69	68,570	.23	111	70,903	.19
28*	70,628	.12½	70	65,824	.24	112	69,577	.20
29	71,550	.22	71	73,488	.23	113	68,480	.24
30	70,850	.20	72	70,176	.21	114	77,712	.20
31	73,136	.19	73	73,408	.22	115	71,855	.19
32	77,600	.19	74	72,592	.19	116	68,204	.23
33	70,288	.25	75	73,136	.19	117	68,845	.19
34*	72,160	.12½	76	69,264	.18	118	69,348	.19
35	69,714	.23	77	71,185	.22	119	65,446	.19
36	70,336	.19	78	73,028	.22	120	69,823	.19
37	68,570	.19	79	67,904	.19	121	69,552	.20
38	71,886	.22	80	68,570	.21	122	73,143	.20
39	70,331	.19	81*	74,736	.12½	123	70,755	.21
40*	68,800	.12½	82	69,936	.19	124*	65,088	.12½
41	72,384	.21	83	64,000	.19	125	67,348	.22
42	77,668	(?)	84	68,590	.12½	126*	76,800	.12½

Summary of Tests.

Mean breaking weight per sq. in. of 114 tests, 72,109.19 lbs.
Do. do. " " " " 12 " *71,786.5 lbs.
12 tests, marked *, were made across the grain.

No. of Tests	between 64 and	65,000 lbs.,	per sq. in.,	1
" "	" 65 "	66—	" " "	3
	None between 66 and 67,000.			
" "	between 67 and	68,000 lbs.,	per sq. in.,	5
" "	" 68 "	69—	" " "	13
" "	" 69 "	70—	" " "	9
" "	" 70 "	71—	" " "	14
" "	" 71 "	72—	" " "	16
" "	" 72 "	73—	" " "	14
" "	" 73 "	74—	" " "	16
" "	" 74 "	75—	" " "	14
" "	" 75 "	76—	" " "	11
" "	" 76 "	77—	" " "	3
" "	" 77 "	78—	" " "	5
" "	" 78 "	79—	" " "	1
" "	" 79 "	80—	" " "	1
				126 Tests.

Assistant Naval Constructor J. F. Hanscom, U. S. N.—It appears to be generally conceded by the naval constructors and marine engineers of prominent European governments that steel is destined to supplant iron in the construction of war vessels.

The advantages resulting are variously estimated, particularly the saving of weight in the hull, which, with the comparatively greater safety in grounding, are the chief objects in view.

Twenty per cent. of the weight of an iron hull of similar dimensions is claimed by some to be practical, while others believe that no material saving in weight can be effected without a corresponding sacrifice in the local and structural strength of the ship. Evidently these are the extremes ; and, since each of the results is claimed by men of acknowledged mechanical ability to be correct, it is possible that a mean between the two might be more consistent with the combined elements of a well-designed vessel.

The characteristics of steel manufactured by the Siemens-Martin process for shipbuilding, as compared with best American iron, are these. Its tensile strength (that is, as limited for shipbuilding purposes) is about 18 per cent. greater. Its ductility and malleability are much greater. It can be as readily worked with shears, punch, or drill, and it has, of course, correspondingly less elasticity and rigidity than iron. The amount of carbon it possesses is said to be from one-half to seven-tenths of 1 per cent. Its specific gravity is about .013 greater than iron.

Referring to certain tests of the comparative rigidity of iron and steel, as recorded in the Transactions of the Institution of Naval Architects, Vol. XIX,

p. 21, I observe that, when reduced to their values for equal sections, the deflection with steel is 2.75 and the permanent set 3.08 times greater than with iron, and that the ultimate breaking-stress was but .927 that of iron, showing the comparatively low limit of elasticity, lack of rigidity, and, when subjected to transverse stress, as in this case, less ultimate strength than iron.

The tendency of steel to corrode when in contact with sea water is generally believed to be greater than with iron, and by some it is claimed to be 19 per cent. greater; but, with the outside, immersed surface of a steel ship substantially coated with paint, and sheathed with two thicknesses of wood, corrosion of the interior only should be considered in comparison with iron.

In order to approximate nearly to the difference in the weights and cost of an iron hull and one of steel of same dimensions, I have assumed a vessel corresponding to the first-class cruiser designed by the Advisory Board, with a displacement of 4269 tons.

Practical results go to show that the hulls of wooden ships of our navy with live oak frame will weigh from fifty to fifty-two per cent. of their respective load displacements. The weight of the "Vandalia's" hull was .507 and that of the "Alaska" .513, respectively.

A cruiser built of iron with scantlings corresponding to the English or French Lloyds, having the necessary transverse water-tight bulkheads and the numerous internal fittings peculiar to a ship of war, and sheathed with five and a half inches of wood, will weigh very nearly as much as a live oak ship of same dimensions.

Taking, therefore, the displacement above mentioned, 4269 tons, 2050 tons would approximate the weight of hull; of this, 460 tons would consist of wood materials, 40 tons of copper sheathing, rudder, stem and post (the stem and post would be brass, probably), leaving 1550 tons of iron. Of this the outside plating, inner bottom, water-tight bulkheads, stringers, ties and keelsons will constitute about 750 tons, leaving a balance of 800 tons for frames, reverse frames, beams, &c., &c.

The propriety of reducing even the longitudinal scantlings of a steel ship from those of iron, in inverse proportion to their tensile strength, is not conceded by many who have given the subject much attention, and as for the frames, angles, beams, &c., which give rigidity to the structure, I confess I can see no good reason to warrant any reduction.

One of two things seems to me to be obvious, either we have in an iron hull designed in accordance with English or French rules for scantlings, an excess of local and structural strength, or in following out the reductions allowed for steel we carry them to a dangerous limit.

In the present comparison, however, I propose to reduce the steel scantlings as allowed by the French Lloyds, which will give in place of 750 tons of iron 615 tons of steel, a reduction of eighteen per cent., and instead of 800 tons of frame, angles, beams, &c., 720 tons of steel, a reduction of ten per cent. We thus reduce the weight of hull 215 tons, which is equal to about eight inches displacement at the load line. Considering the cost, we have in the first place 1550 tons of iron at $78.40 per ton=$121,520.00, and with the steel hull we

have 1335 tons of steel at \$145.60 per ton=\$194,376.00, an excess in cost for the steel hull of \$72,856.00.

To sum up then, we have reduced the entire weight of hull eleven and four-tenths per cent., the total displacement five per cent., and the draught of water eight inches, at an expense of nine per cent. of estimated cost of iron hull.

The result of experiments in towing H. M. Ship "Greyhound," (also recorded in the Transactions of the "Institution of Naval Architects," Vol. XV), show that in lightening, or lessening the displacement nineteen and one-quarter per cent., there was a reduction of but ten and one-half per cent. in the resistance. Applying the same ratio to the case I have assumed, the resistance will be reduced but two and seven-tenths per cent., and it is obvious that the consequent increase of speed with the same boiler power maintained (or the possible reduction of boiler power to maintain the same speed) would be small if not insignificant.

The cost of iron and steel plates manufactured in the United States at the present time is about three and one-half and six and one-half cents per pound respectively.

The Nashua Iron and Steel Company, of Nashua, N. H., is prepared to furnish ship plates equal to 2000 pounds in weight, of convenient dimensions, which would probably exceed any plate used in the construction of a steel hull.

They depend on chemical analysis for uniform consistency, and subject a sample of each plate to a hot and cold test. Mr. John Roach is also preparing to manufacture steel plates by the above process, but as far as I can learn there are no facilities for making steel angles, channels, beams, &c., in this country.

It would seem advisable at this time, when we have reason to believe that our naval fleet is to be essentially increased, that we should take advantage of the greater experience of European governments both in design and materials ; the question of cost in the adoption of steel should not, I believe, be considered, if the advantages accruing are sufficient to provide for the remotest contingency.

While I do not believe that we can safely reduce the weight of a steel hull twenty per cent. below one of iron, the experience and reputation of those who have sanctioned the reductions carried out in the foregoing approximation are enough to warrant its practicability. The transfer of 215 tons from the hull to battery or fuel, together with the assurance of greater safety in grounding or colliding, are advantages which at least entitle this material to a practical test.

Naval Constructor W. L. Mintoyne.—I have some figures concerning the "Iris," English steel corvette, that will show you all the greatest saving yet effected by the use of steel in men-of-war.

Of her total displacement the steel hull was 38.5 per cent., or 1501.5 tons ; her rigging, armament, stores and equipment, 13.5 per cent., or 526.5 tons ; her engines, boilers, &c., 28 per cent., or 1092 tons ; coal, 20 per cent., or 780 tons. The total reduction of weight by the use of steel in her hull was 175 tons.

Lieut. Bassett.—It was estimated some time ago in England that the cost per ton of a 4000-ton iron ship would be £6 12s. The cost of a steel ship built from the same drawings would be £8 9s. per ton, or in all, for the hull, £900 more than the iron ship. But in the steel vessel, by the use of thinner angle irons, beams, &c., with less weight, 81 tons more freight would be carried. This, at an average of £6 2s. per ton, would amount in a year to £481 freight money—more than one-half the increased cost, besides the difference in wear and tear in favor of the steel vessel.

This element of gain comes in when we consider the man-of-war, since, with the least draught, we would gain the greatest capacity for coal, and hence any increased storage-room is an advantage.

As to corrosion, I remember to have seen it stated in an English paper that it was kept down by washing off the scale from the hull with weak acid and then painting it. I do not know whether it has been extensively tried or not.

The Chairman.—I have been greatly interested in the papers that have been read, all of which are so strongly in favor of steel for shipbuilding. Much could be said, however, in favor of iron, although it seems clear that steel will be the material of which ships will be built in the near future.

We must not, however, attempt too much, and it will not be safe to use steel plates of high tensile strength—not 120,000 per square inch as stated by one gentleman—probably not more than half that.

Perhaps the safest way would be to fix a minimum of elongation at fracture of, say, 25 or 30 per cent., and leave it to the makers to accomplish as high a tensile strength as possible with that elongation.

High tensile strength is objectionable, only in that the ductility of the metal is greatly reduced in producing it.

I will mention as an example a test made by myself. Two specimens cut side by side from the same forging were tested, when cold, without any evidence of flaws or cracks—one being first annealed, and the other tempered in oil at a low red heat. The results were :

	Tensile Strength.	Elastic Limit.	Elongation.
Annealed,	86,500 per square inch,	34,000 per square inch,	25 per cent.
Tempered,	139,000 "	86,000 "	8 "

This was, of course, a higher steel than would be used for shipbuilding.

There seems to be no question about the ability of our makers to produce all the "low" steel we will ever need for shipbuilding—steel, too, of the very best quality for that purpose.

Steel for boiler plates is now extensively made having a tensile strength of 58,000 lbs. per square inch, an elastic limit of 32,000 lbs., and an elongation at fracture of 32 per cent.

This metal is so "low" in carbon that it will not "temper" or harden if quenched in water at a moderate heat, and it is said that annealing does not affect it. It is punched like iron, and flanges can be turned cold.

Civil Engineer U. S. G. White.—I would ask, Mr. Chairman, whether or not the ultimate strength of both iron and steel, as given by manufacturers, is not very much exaggerated. I saw quite a number of specimens of steel, manufactured by the Nashua Company, tested at the Watertown Arsenal, and I do not think any of them withstood a tensile strain of 50,000 lbs. per square inch. In testing bolts five and one-half inches in diameter, Captain Eads found they failed at 30,000 lbs. per square inch, while small bolts three-fourths of an inch in diameter, made from the larger ones, showed no signs of failure under a strain of 100,000 lbs. In considering the relative merits of iron and steel as materials for shipbuilding, I wish to call your attention to the U. S. S. Michigan, on the lakes. She is built of iron—the best charcoal. How long she has been in service I am unable to state ; but during her service she has had some very severe tests, one of which I will mention, when she went on to a pointed rock, upon which she hung and swung for hours. Much trouble was apprehended from leakage upon getting her off ; but a subsequent examination of her bottom showed simply a large dent in her skin, the iron showing no signs of failure whatever.

Chief Eng'r E. D. Robie.—Tensile strength must be kept down, to possess other necessary qualities. The British Admiralty limits it to thirty tons. Encouragement to manufacture is necessary, but eventually the steel manufacturers will make the required material easier and cheaper than iron.

Capt. Chandler.—With regard to our American iron I note from some trials published in the New York Engineer, the following strengths :

Iron	from	Salisbury, Ct.,	40	trials	58,009 lbs.
"	"	Sweden,	4	"	58,184 "
"	"	Centre Co., Pa.,	15	"	59,400 "
"	"	Essex Co., N. Y.	4	"	59,962 "
"	"	Lancaster, Pa.,	5	"	58,661 "
"	"	Russia,	5	"	76,069 "
"	"	Lake Superior,	1	"	89,582 "

If this can be taken as an estimate we can certainly make the best iron in the world.

Chief Eng'r Robie.—The steel wire used by Sir Wm. Thompson for deep sea soundings had a tensile strength of 149,000 lbs. to the square inch. In this country it has been made of a tensile strength equal to 160,000, but such steel is unfit for shipbuilding.

The Chairman.—The results given by the testing machine will vary greatly with the size of the specimens tested—the smaller the specimen the higher the result. Unfortunately there is but one machine in the country, as far as I know, that will break steel specimens of over one-half square inch cross section, and generally one-fourth square inch is used. This serves very well for comparison, but it does not give the absolute strength of larger pieces.

NAVAL INSTITUTE, BOSTON BRANCH,

JANUARY 31, 1882.

LIEUT. F. W. NICHOLS, U. S. N., in the Chair.

DISCUSSION ON OCEAN LANES.

HON. R. B. FORBES.—* I would call attention to the pressing necessity for the consideration of separate tracks out and home for steamers navigating the Atlantic. As long ago as 1854 the subject was broached, and early in 1855 Lieut. M. F. Maury, at the instigation and cost of a board of underwriters of New York, published a chart illustrating what he called Ocean Lanes. At that time it was estimated that a steamer left one side or the other, on an average, every five or six hours. At this time the statistics of Mr. Nimmo show that one leaves every two hours. Adding to his list, which comprises only foreign steamers coming to the United States, the American steamers from Philadelphia, and the steamers running in summer to British Provinces, I estimate that we have one for about every hour and a half. If it was thought prudent twenty-six years ago to consider the subject of different routes out and home, it would seem vastly more so now that we have more than three times the number of steamers crossing the Atlantic, each going on her own course, but nearly on the same tracks out and home. The danger of collisions is vastly increased; keen competition by steamers, running much faster than formerly, adds to the risk.

There have been some improvements in the interest of safety, such as better methods of lighting, better steering, better modes of signalling, and a more extended experience; still, the danger is much increased.

Referring to some new suggestions for automatic sound signals, of which several have been made, I would say that which is the simplest is the best. One plan is that of Admiral Beaumont, which has been applauded by well-known experts, notably by Captain Moreland of the Cunard line. This plan gives blasts of the whistle for every two points, with pauses between them. If I may so speak, it is too good; it aims at too much. On the broad Atlantic, for steamers going out and coming home, all we want is a signal during thick weather that will denote *east* or *west*, let it be understood as *out* and *home*.

* Read Dec. 31, 1881.

When in narrow waters, as the English Channel and on our coast, it will be enough to denote northerly and southerly; the officer on the bridge has cares enough on his shoulders and noises enough in his ears not to want blasts of the whistle for every five minutes—blasts which tend to cut off the sound of signals from others.

An effort was made in 1874, through a committee appointed by the Social Science Association and by the Technological Society of Massachusetts, to call the attention of steamship companies and foreign governments to the necessity for establishing separate tracks. The committee was composed of well-known merchants and experts of Boston, New York, Philadelphia and Baltimore, and was aided by Commodore R. H. Wyman, who reprinted Maury's paper on ocean lanes. The late Professor Benj. Pierce was a member, and felt a great interest in the subject; he was in Europe at the time, and much aid was expected from his consultations with foreign associations, but no progress was made; there was a difficulty in getting at parties who controlled steam lines, and a spice of jealousy perhaps existed between rival lines.

I fear nothing can be done until a general convention of steamship companies takes up and considers the subject. Nothing short of this will answer, unless we wait, and wait not very long, for a disastrous collision between two passenger steamers.

One considerable advantage in establishing separate routes will be found in greater safety to Bank fishermen. If we mark on all charts a track, say thirty or forty miles in width, narrowing it to less at certain necessary crossings of routes and on certain banks, the fishermen will naturally avoid these tracks. Another considerable advantage will be found in the fact that vessels in distress, and yet in condition to control their course in some degree, will know where to find succor. I have just corrected a proof of a short paper on ocean lanes intended for the *Army and Navy Journal* of next week, and have furnished other papers to the *New York Herald* and the *New York Nautical Gazette.* The subject cannot be too extensively discussed, and I hope that some members of the Naval Institute will give their views.

Lieut. F. S. Bassett.—In 1854 the steamer Arctic collided with the Vesta in a fog off the Banks of Newfoundland, and 323 lives were lost. In the newspaper comments that followed so dire an accident many things were suggested and urged as remedial or preventive measures against the many dangers of fog, collision, ice, and winter storms. Among these, the present subject, that of ocean lanes, then first suggested by our venerable associate, Mr. R. B. Forbes, was discussed at some length as being one of the more important of the *preventive* measures. Commodore (then Lieutenant) M. F. Maury, United States Navy, took up the subject and elaborated it in a letter to W. R. Jones, Esq., of the New York Board of Underwriters. Afterward, in response to an invitation from Messrs. Sleeper, Cartwright, Forbes, Bowditch, and others, underwriters of Boston, he further studied the subject, and in 1855 his pamphlet on ocean steam lanes was published at the Government Printing Office. He there states that he had carefully examined the logs of 46,000 days con-

cerning the wind and weather of that part of the North Atlantic principally occupied by the mercantile fleets of either hemisphere. He then laid down two tracks, or lanes, twenty miles wide, to one of which, the most northern, he proposed to confine the steamers westward bound, and to the other, situated from one to ten degrees south of it, the eastward-bound steamers were to conform. He argued, and brought data to support it, that the westward-bound passage would be shortened by following the lane, and the eastward-bound track would not be materially longer. By confining steamers to these narrow lanes, and advising sailing vessels to keep off from them, or if compelled to cross them, to do so as soon as possible, he contended that the chances of collision would be far less. He also argued that westward-bound steamers arriving on the Banks would be able to tell their position by temperature and soundings, so as to diminish the chances of running ashore.

For some time after Maury's labors had been given to the subject, it languished. In this country, the decline of our merchant marine began about this time, and the Civil War followed; and so the subject was allowed to drop. But within the past few years it has again been revived, and periodical letters and articles on the subject have appeared in nautical and popular publications in this country and in Europe. Mr. Forbes has been prominent among those agitating the matter, and it is to his paper read here at our last meeting that the present discussion is due. Mr. Archibald, British consul at New York, has agitated the subject in the English publications, and there have from time to time appeared letters from mariners, ship captains, and others, in the *New York Herald*, the *Nautical Gazette*, *Army and Navy Journal*, and other publications.

In 1873 the Bordeaux Chamber of Commerce addressed to the Minister of Marine a memorial urging the adoption of steam lanes. The same year, Commodore Maury's pamphlet was republished at the Hydrographic Office, and Commodore Wyman, then Chief Hydrographer, strongly recommended the adoption of these steam lanes. In 1874, Prof. B. Pierce read a paper before the American Academy of Science and Arts, advocating the adoption of these steam lanes, and strongly urging the consideration of the subject at once. In 1876 Mr. Archibald, in a letter to the *Nautical Magazine*, of London, suggested a conference of representatives of transatlantic lines, lay and nautical, and urged the adoption of steam lanes much on the same grounds urged by Maury.

Of all the many measures, remedial and preventive, urged by various persons after the Arctic and Vesta collision, this one of steam lanes has received the least attention from the authorities. Life-boats, better lights, rules for the road, examination of officers, and other measures have each had their turn and have served their good purpose; but this, apparently the most effective preventive measure, has received no attention from our laws.

Collision is the greatest danger that will be removed by the adoption of separate tracks for steamers. This cause of wreck and disaster produces from one-fourth to one-sixth of the calamities of the world's shipping; and to judge from Professor Rogers' tables, it is a constantly increasing one. He finds that in Great Britain there has been an increase in the number of collisions amount-

ing to 23 per cent., while the number of vessels decreased 1 per cent. in the period under consideration (1856 to 1873).

The collision (and loss) of the Arctic with the Vesta was followed by the Lyonnais and Adriatic collision, involving a great loss of property and life. In 1880, 200 vessels were lost by collision, of which thirty were steamers. Many of these would surely have been avoided by the adoption of lanes.

To these collisions, probably preventable, must be added the list of missing ships. From July, 1877, to July, 1879, this list amounted to 150 vessels and 2381 men, followed in the next fifteen months by 105 vessels, of 41,000 tons, and 1285 men. In 1880 there were eleven steamers missing. From 1866 to 1869, Professor Rogers tells us, of 10,588 vessels reported lost, 849 were missing, about one-twelfth of the whole number. It is also remarkable that most of the wrecks, collisions, etc., are during light or moderate winds ; and, according to the same authority, 45 per cent. were declared due to preventable causes. Further, the same authority tells us that British statistics prove that the increase of wrecks outside of home waters was proportionately greater than those within those waters. The former increased from 935 in 1867 to 3094 in 1873, while the latter decreased from 2090 in 1867 to 1803 in 1873. This proves that the adoption of other remedial and preventive measures tended to reduce accidents, but that the danger of such was rendered greater by the increased navigation beyond seas, and that we must look to some further means of decreasing casualties there.

It is for the safety of the sailing vessel, as well as for that of the steamer, that the adoption of these lanes is urged. This will be the better for the sailing vessel, as Maury urges, since, from his charts, the fogs and calms occur most frequently across the lanes.

The lanes laid down by Maury may, however, require some modifications. In the first place, they will in all probability have to be widened. Maury's twenty miles might have accommodated the steamers engaged in transatlantic traffic at that date, but it will probably be found too narrow at this time. The advantage of a narrow lane is that the sailing ship may readily cross it when she finds herself in it ; but now steamers leave port more frequently to cross the Atlantic. Mr. Forbes told us that they left either side at the rate of one each hour and a half. A letter from a prominent British ship owner to the English Board of Trade, in 1879, published in the *Nautical Magazine*, tells us that 2500 steamers leave Europe yearly for America, and as many return. This would be about one every three hours, so that Mr. Forbes' estimate is about right. Allowing fifteen days to the trip (including loading and discharging), we would have some seventy steamers at sea, bound in one direction, or, distributing them over a track of 3000 miles, a line of steamers 45 miles apart. There should be given more room than that allowed by Maury's lanes.

The widening of these lanes would also answer many of the objections urged by steamer captains against them. One often given is that there is a loss of freedom in adopting them, and in being confined to a route—a want of control over the movements of the vessel that is necessary to the experienced

mariner. This would in some measure be met by the adoption of wider lanes, and besides, so much care and attention on the part of the captain to keep the ship in the lane would not be required.

With all due respect for Mr. Forbes' opinion, I do not think it an impossible thing for a fast steamer to catch and run down a slower one. Suppose, for instance, a ten-knot freight steamer leaves New York at 4 P. M., and a fourteen knot passenger steamer at 6 P. M. The latter will probably overtake the former about 11.30 P. M.—about the time the first watch officer is getting a little drowsy, the lights just beginning to burn dimly, and the lookouts well into the merits of their final yarn. It is easy for a ship to creep up on another, without the pursuer being aware of it, on a very dark night. But we may lessen this danger by adopting the wider lanes, and require fast steamers to keep on one edge, and slow steamers on the other.

We should also remember that the danger of collision is greater with the noiseless screw-propeller, the low pressure engines, and long and unhandy steamers.

The adoption of lanes would render the possibilities of aid to sailing vessels in peril greater, since steamers in them would be able to succor the distressed sailer who bears up towards the lane, thus serving as a string of lifeboats across the ocean.

The lanes may also have to be removed to the southward of Maury's projected tracks. The argument used by Maury in favor of the lanes, that fogs and calms occur most frequently along them, is used by Captain Shackford of the steamer Illinois, in communications to the *Nautical Magazine* and *New York Herald*, as a reason for taking a more southerly passage. Instead of crossing the meridian of 50° at 45° in coming westward, and at 42°–43° in going east, he would cross it at 40°–41°. We may perhaps find it necessary to compare with Maury's labors the testimony of the experienced captains of our merchant steamers, and the comparison will be useful in determining the location of the lanes.

Captain McKay, in communications to the *New York Herald*, has another plan of modifying the lanes, by which he would confine sailing vessels, and not steamers, to a lane. He proposes a lane 30 miles wide. Steamers bound one way will keep south of the southern limit of this, and steamers bound the other way north of the northern limit. He urges that this plan will obviate the danger of collision, render it easier for the sailing vessel to bear up to the lanes for relief, and would not be open to the objection of too much restriction on the captain of the steamer.

While this might, with some modifications, be worthy of consideration, it is a very slight change from the existing order of things, and a change only in the direction of restricting the sailing vessel. It seems then somewhat hard on the latter to say that 60,000 sailing vessels, at the mercy of the winds and waves, shall be limited to a narrow lane, while the 7000 steamers shall be allowed to roam at will, except in this narrow forbidden strip.

It is to be hoped that the attention of those who own ships, those who sail ships, and those who go in ships or send produce therein, may be brought to

this subject, for it is quite probable that it will require a popular demand to obtain anything in favor of these lanes, either from the companies or from the governments.

LIEUT. E. T. STRONG.—The subject of Ocean Lanes in the navigation of the North Atlantic is one which should claim the attention and interest of all who are directly or indirectly connected with mercantile pursuits, both in this country and in Europe; and since the routes under discussion form an important part of the world's great highway of travel and commerce, upon which representatives from all the nations of the globe are continually passing and repassing, and over which agricultural and mechanical products from all parts of the world are carried, the subject is one in which all the nations of the civilized world should take the greatest interest.

As the amount of traffic between the United States and Europe has increased during the past twenty-five years, public attention has from time to time been called to the subject of rendering life and property more secure upon the ocean. Great improvements have been made in the construction of steamers, which, with water-tight compartments, are rendered less liable to loss by foundering in case of collision with other vessels or with ice; life-rafts have been invented, and are now in use on board of passenger steamers, to take the place, in some measure, of the lack of carrying capacity of the steamer's boats for the number of passengers to be accommodated; life-buoys and cork mattresses are at hand to serve as a means of saving life, and the inspection of steamers, by authority of government, to enforce the provision of all these means of saving life is thorough and frequent.

Besides these numerous preventive measures that have been taken against the danger by collision or shipwreck, improvements have been made in signals and in the lighting of vessels; the "Rule of the Road at Sea," by which the movements of vessels in proximity to one another are governed, has become a law among maritime nations, and we must not omit to mention the fact that twenty-five years' additional experience in the exclusive navigation of the North Atlantic by those engaged in that business, ensures a greater degree of safety to life and property.

All of these improvements are steps in the right direction, and they have been called forth by the demands of the travelling public that the risks of ocean travel shall be reduced to a minimum; but nearly all of the steps which I have mentioned are to give additional safety to life after collision has actually taken place. It cannot be said that all precautions have been taken until the danger of collision itself has been reduced to a minimum by instituting fixed routes or lanes, to which the movements of all steamers passing between the northern ports of the United States and of the Provinces and the northern ports of Europe shall be confined.

If in 1854 this subject was considered worthy of notice, of how much greater importance is it at the present time! From 1856 to 1880, the amount of tonnage, foreign and domestic, entered at United States ports from England, France, Germany, Belgium and Italy, has increased 4½ fold; and the steam

tonnage entered at United States ports from 1864 to 1880, inclusive, has increased nearly 9 fold, of which, it is hardly necessary to add, the greater part of the increase is found between the northern ports of Europe and of the United States.

The interests of all lines of steamers are the same: the quick transport of passengers and freight. The route which would naturally be taken is that of the shortest distance, or as near a great circle as the outlying dangers of Newfoundland and Nova Scotia will permit. Although the varying circumstances of wind and weather may cause a wider track to be occupied in mid ocean, and less danger of collision be experienced, the convergence of the tracks near the coast of North America and the British Islands plainly shows the greater danger to which vessels are exposed in those portions of the voyage. Steamers from Baltimore, Philadelphia, New York, Boston and Halifax all enter the great highway but a few hundred miles from their ports of departure, and the same is true for those leaving the ports of the English Channel or the western coast of England and Scotland. Comparatively speaking, the route is crowded both by steam and sailing vessels, bound both to the east and west, and to add to the dangers of collision, the speed which steam vessels are capable of maintaining is gradually upon the increase.

The passage formerly made from New York to Liverpool in twelve days is now frequently made in eight days. The average of seven passages of the City of Chester of the Inman line is 8d. 5h. 47m., and of the City of Richmond 8d. 10h. 40m.

The Germanic, of the White Star line, made the passage from Queenstown to New York in 1875 in 7d. 23h., at an average of 14½ knots for the entire passage, and on the 26th of the present month the Cunard steamer Servia arrived at Queenstown in 7d. 12h. from New York, at an average speed of 15½ knots per hour. Even this speed is soon to be surpassed by the "dome" steamers, which are intended to make the passage in six days, and perhaps less; and as the demands of the public for quick transit are complied with by the construction of vessels of greater speed, the dangers of navigation are continually increased. It cannot be doubted that the steamers of all the different lines are commanded and officered by experienced and capable seamen; but in spite of the greatest care and watchfulness upon their part, in the darkness of the night or in foggy weather, disasters have occurred, and are always liable to occur between vessels running upon opposite courses, bringing with them the constant liability to loss of life and property.

Aside from the consideration that greater safety from collision would result from the establishment of ocean lanes, the safety of vessels in distress and their greater liability to obtain assistance should not be forgotten. Disabled steamers being within the limits of the lane could hardly fail to be seen by others and have assistance rendered. The masters of sailing vessels in distress outside the lanes would know to a certainty within what latitudes assistance could be obtained. The present winter, with its violent storms and disasters to shipping in midocean, teaches us a lesson upon this subject which should not be disregarded.

This subject has been discussed from time to time during the past quarter of a century. It was thoroughly investigated by the late Lieut. Maury as early as 1855. Tracks were delineated upon his charts showing what he considered the most favorable routes that could be taken for ocean lanes. Although it is hardly necessary that I should describe them, a passing notice may not be without interest.

The lane from America to Europe is the more southern of the two, in which advantage is taken of the easterly current of the Gulf Stream. The shortest distance between Sandy Hook and Liverpool that a ship can take is 3009 miles. By the lane recommended by Lieut. Maury, measuring through the centre, the distance is 3144 miles. The difference between this and the great circle route would probably be made up by the favorable current of the Gulf Stream.

The proposed lane for steamers bound to the westward is but 29 miles longer than the great circle track, while it has the advantage of skirting the northern edge of the Gulf Stream, where an eddy is frequently found, the average strength of which is estimated at ½ knot per hour. The northern boundary of this track crosses the Banks of Newfoundland at a distance of 100 miles south of Cape Race, and 45 miles from Virgin Rocks, the most dangerous locality of the whole passage, if the shortest route is taken, on account of the fogs, currents and outlying dangers of the coast, and where time is often lost in running at a slower rate of speed as a precautionary measure, or in steering to the southward in order to clear these dangers. The advantages of Maury's routes are undoubtedly well understood by those who are continually crossing the Atlantic, and they, or routes of equal safety, are taken by many; but confusion will arise and liability to collision occur unless the tracks for all are the same. Many of the steamship companies have already established routes for their own steamers.

The White Star line advertises to follow those advocated by Maury. The Cunard steamers take the southern route upon their trips, the ships bound to the westward crossing the meridian of 50° nothing north of 43°, and those bound to the eastward crossing the same meridian nothing north of 42°. The Inman line take also the southern passage, avoiding as much as possible the fogs of Newfoundland.

Undoubtedly these lines, and perhaps others which I have not mentioned, take these routes as the safest and most popular with the travelling public, at the small sacrifice of time which is required by them. If all owners of steamships, and those who control their movements, could be persuaded that it is for their interest that all should follow the same track, the agreement as to ocean lanes could easily be accomplished.

One of the objections that has been offered to the proposed enforcement of ocean lanes is that the commanders of steamers should not be limited to certain latitudes, but should be left to their own experience and judgment. But their routes are to a certain extent limited by the companies by which they are employed, and that their judgment and skill are not at all times infallible is shown by the fact that the best appointed ships are at times swept to destruction near the ends of their routes, and that collisions do occasionally take place in mid ocean, with loss of life and property.

It has also been urged that steamers would not at all times be able to keep within prescribed limits of latitude, as, for instance, during heavy weather, when it may become necessary to heave to; but it is seldom that the larger steamers of the transatlantic lines are unable to keep upon their course. The reports that have come to us during the present winter are exceptional. Many steamers have been delayed in their passage to the westward, but in spite of delays they could, no doubt, have retained their position within given limits of latitude had it been required. I consider that the width of a lane recommended by Lieut. Maury is too small; that in place of having a width of but 25 or 30 miles it should be 60 miles, to accommodate the large number of steamers passing over the routes. With a lane of this width, I think that it would be only in extreme cases that steamers would be unable to retain their positions; but if obliged by stress of weather to drift outside the limits, as has been remarked by Lieut. Maury, their position would be no worse than it is at present. If it is considered that by allotting a width of 2° of latitude to the exclusive use of steamers, the rights of sailing vessels upon the world's highway are infringed upon, I answer that it is as much for the safety of sailing vessels as steamers that ocean lanes should be enforced. Steamers, with their superior motive power, should be limited to certain latitudes which sailing vessels should avoid, if possible, unless in need of assistance, while the latter have the space between the lanes and to the north and south of them.

Statistics of commerce show the great increase of tonnage of steam vessels over sail vessels built during the past fifteen years. From the port of New York alone, during the year ending June 30, 1880, three-fourths of the value of exports to the United Kingdom, France, Germany, the Netherlands and Belgium, was taken by steam vessels, while about four-fifths of the imports from those countries to New York was brought in by steam vessels. These facts in regard to the commerce of one port only (although the most important) of the United States show that steam vessels are more largely employed than sailing vessels; that it is to steamers that the more valuable freight is entrusted, and that upon them, to the almost entire exclusion of sailing vessels, thousands of passengers are continually crossing the North Atlantic. It follows, then, that the interests of commerce demand that the rights of steam vessels should be protected and their safety provided for by competent legislation, even at the expense, if necessary, of some inconvenience to sailing vessels.

The arguments that I have enumerated in favor of ocean lanes have already been advanced by different writers, but they are brought home to us with increased force year by year as commerce increases between the two continents. The necessity of increased care in the navigation of the North Atlantic can be but evident to the most casual observer. Whether the lanes should be those recommended by Maury, or others farther south, increasing the distance, but entirely avoiding the fogs of the Banks of Newfoundland, I will leave for others to determine. That I consider to be a question of secondary importance. The question is not so much at present, "Where shall the limits of the lanes be fixed?" (so long as they do not lead into danger), as it is, "When shall the necessary steps be taken for enforcing

such lanes?" That there is a general feeling among steamship companies and their officers in favor of ocean lanes is shown by the increasing agitation of the subject, and by the adoption of the safer and less crowded routes by many of the lines. I am of the opinion that the agreement to the adoption of these lanes by steamship companies is not sufficient in itself, but that the enforcement of such lanes, and the protection of the rights of both steam and sail vessels in regard to them, as well as penalties for the infringement of them, are matters for legislation and mutual agreement between the maritime nations of Europe and the United States.

The great resources of this continent are being developed year by year with amazing rapidity. New railroads are continually being built, opening up to agriculture and trade a large amount of new territory yearly. The markets for our surplus productions are found in the countries of the eastern hemisphere, and the amount of the carrying trade between the United States and Europe must increase for many years to come.

No time should be lost in giving the greatest possible security by proper legislation to the lines and property engaged in these pursuits.

HON. R. B. FORBES.—To recur to what was said at the last meeting on the subject of different tracks, out and home, for steamers crossing the Atlantic, I would call attention and invite discussion on what is said in the *New York Herald* of the 12th instant. It is there suggested that a space of about thirty miles in width be laid off and called "neutral ground," all steamers coming west to keep to the northward, and all going east to keep to the southward. This appears to me to be a fair compromise between the advocates of the Maury lanes, of which I am one, and those who want more space, and I think the suggestion well worth consideration. Parties who are wedded to great circle sailing, who are fond of fogs and ice, can then shave Cape Race and Sable Island, and those who value the slight aid they can get from the Gulf current may follow it.

I have another suggestion to offer, and that is to change the routes for different seasons: from the first of April to the first of October to go and come either by Maury's tracks or as suggested in the *Herald*, and from the first of October to the first of April to go eastward as nearly on the great circle as possible. From all parts of the United States on the Atlantic this would carry steamers near Cape Race; and as the winds at this season prevail from the westward, with generally clear weather, this route would be popular with most navigators, and it has the merit of carrying them near to ports of succor. Coming westward in the winter, cautious navigators would take the southern route, and if it should be laid down right, they would have the favorable counter-current prevailing on the northern edge of the Gulf Stream, the position of which can generally be ascertained by the water thermometer. In very stormy seasons like the present, much may be gained in time and comfort by keeping to the southward of the usual course. Meeting one of the experienced Cunard captains the other day, I said to him, "How is it that you make so much better weather of it coming this way than your competitors?" He

smiled and said, "When I get a northwester which I cannot face I give her a good hitch to the south, and I soon find weather which I can safely face, while they are lying-to or contending against seas which damage them."

I hope that some of you who have access to charts will consider these mere suggestions, and lay down the neutral ground, for discussion at some future meeting.

Lieut. J. C. Soley.—The reports of the masters of the different steamers which have been crossing between this country and the northern ports of Europe serve to show that, with ever-increasing steam travel, the safety of vessels demands that vessels should be restricted to certain routes. While the currents, prevailing winds, and general weather indicate that eastward-bound vessels should take a northerly route, the same considerations make it advisable that westward-bound vessels should take a more southerly course. But these considerations will vary with the seasons, and therefore I do not think it would be practicable to confine shipmasters to any lanes, properly so called, which have a northern and southern limit. No more do I believe in the feasibility of laying off any neutral ground to be used by sailing vessels, because they should be the least hampered. I do not believe it would be possible to secure any international legislation which would accomplish such an end, nor do I believe it would be advisable. I am in favor of allowing more latitude by fixing upon a certain line and requiring eastward-bound vessels to keep to the north of it and westward-bound vessels to keep to the south of it. Sailing vessels would probably keep these routes from preference, even without any legislation, if they knew that steamers always observed them. This alone would diminish in an immense degree the dangers of collision, and would facilitate the saving of shipwrecked persons much more than if there were a neutral ground.

Lieut. F. S. Bassett.—I particularly emphasize the necessity of overhauling Maury's work. That great scientist did his task well, but the experience of twenty-five years has shown conclusively, at least to some, that more southern routes are to be adopted. Capt. Shackford, in taking this ground, gives extracts from the logs of various steamers, showing that those adopting southern routes had good winds and weather, while those on more northern tracks encountered fogs and gales. It is possible that the winds, since Maury's work was done, have changed their character, and that fogs, etc., were more frequent than even he supposed on these lanes. At any rate, more attention must be paid to the steamer companies, and it will probably be found necessary to get combined views of our principal commanders, and endeavor to reconcile them, if not to Maury's, then to modified lanes.

Lieut. E. T. Strong.—It seems to me the adoption of Ocean Lanes can be as easily made a subject for legislation as the Rule of the Road has been, or the agreement to an International Code of Signals, both of which are steps taken for the greater safety of shipping at sea. I cannot agree with the suggestion of Lieut. Soley that it would be sufficient that the different

steamship companies should agree among themselves to adopt certain routes for their steamers. Freedom would still be given to those who did not wish to enter into such an agreement, to cross either inside the lanes or outside of them, and there would be nothing binding. Mr. Forbes speaks of the establishment of different lanes for summer and winter passengers, which I think would tend to confusion. The reason of this change of route is for the avoidance of fogs or ice, or to obtain more favorable winds or less unfavorable ones. But as steamers are not dependent upon the wind during the passage, I think that a certain route could be taken which would have but few disadvantages either in winter or summer, and the difference of one hundred miles in a passage is of but little importance when a day's run is often three times that distance and even more.

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NOTES ON THE LITERATURE OF EXPLOSIVES.*

By Prof. Chas. E. Munroe, U. S. N. A.

Among the curious applications of the high explosives is their use in clearing out the obstructions in blast furnaces which are still in operation. An account of this use of them is given in the *Transactions of the American Institute of Mining Engineers* for October, 1881, by Mr. T. F. Witherbee. Owing to some irregularity in working the furnace a thick pasty mass filled the tuyere circle, stopping the tuyeres and threatening the furnace with freezing. In this emergency, after trying in vain to dig out the mushy material, a hole was driven in the mass, and a 5-inch pipe, with an end welded in, was packed in the hole with clay and cooled by a stream of water injected into it. The cartridge consisted of a piece of 3½-inch gas-pipe, plugged with wood at each end and loaded with thirteen ordinary 1¼-inch Rend-rock cartridges. This was shoved into the 5-inch case, tamped or sealed with a ball of clay, and fired with all possible dispatch, as the 5-inch case was red hot. It failed to explode, as also did a second one, and the powder, on examination, was found to be worthless. Two days after a hole was worked back two feet into the furnace, charged with twenty-five Atlas cartridges, and exploded without doing the furnace any appreciable damage. Before loading, a test was made to ascertain the danger, by putting a handful of powder into a dry pine box, similar to the cartridge case to be used. It remained three and a half minutes in the hole before it ignited, showing that there was but little risk, especially as the real cartridge case was wet and coated over with blue clay.

*As it is proposed to continue these notes from time to time, authors, publishers and manufacturers will do the writer a favor by sending him copies of their papers, publications or trade circulars.

Under the title, "Scaffolds and Engorgements in Blast Furnaces," a summary of various methods of using explosives, etc., in removing them is given in the *School of Mines Quarterly*, III, 4, 304.

In the same Quarterly, 296, it is stated that Nobel's Blasting Gelatine and Gelatine-Dynamite have proved very efficient in the St. Gothard tunnel. The principal fact established during the use of these explosives is that the relation between the blasting gelatine and Nobel's common dynamite is about three to five. Gelatine dynamite has more of a pushing than a breaking effect, and is hence advantageously applicable to quarries, and on the whole its effect and economic value is about the same as that of common dynamite. With the stronger of the new explosives, blasting gelatine, where boring is expensive, the same work may be accomplished with the boring of three holes, as with five holes charged with common dynamite. The gases from both gelatine dynamite and blasting gelatine did not inconvenience the workmen, even immediately after the blast.

In the same Quarterly, 250, will be found an account of the accidents due to explosives at the mines in the Marquette iron region.

Major Lauer claims that his method of pulverizing rocks in the beds of rivers by exploding dynamite on their surface leaves them in a condition to be removed by the current. Cartridges inserted in drill-holes break them in large fragments, requiring mechanical removal often at great cost.—(*Journal Franklin Institute*, 678, 451.)

"Dynamite and its Manufacture" is the title of a lively and popular description of the works at Ardeer, in Ayrshire, and the processes employed there. As it is announced as the first of a series of articles, it will be noticed hereafter.—(*Engineering*, March 10, 1882.)

Both *Engineering* of Nov. 25 and *The Engineer* of Dec. 2, 1881, give a lengthy account of a recent gathering at the Stowmarket Explosives Works, to witness the trial of their products, among which were the new gun-cotton sporting powder and a new form of dynamite. The articles open with descriptions of the manufacture of the ordinary gun-cotton, that in *The Engineer* being quite full and accompanied by drawings and data. According to *Engineering*, the new gun-cotton powder or rifle gun-cotton is not submitted to any pressure, the gun-cotton proper being incorporated under metal

rollers with another material, the nature of which is kept a secret; it is then roughly granulated in perforated revolving zinc drums, and eventually passed through a sieve suited to the size of grain desired. In appearance this new powder is of a bright yellow color; the grains are about the size of those of ordinary sporting powder, and extremely uniform both in size and shape. It is quite water-proof, and may be placed for months under water without injuring its qualities. *The Engineer* says: "This sporting or rifle powder is made of a combination of gun-cotton with nitrates of soda and potash, being in fact very nearly Mr. Abel's nitrated gun-cotton. The grain appears hard and firm, comparing favorably with Schultz's powder, and it is glazed, so that it may be thoroughly wetted and dried again." It is claimed that a given weight of this material is equal in explosive force to nearly three times the quantity of gunpowder, while at the same time the recoil is very slight, and there is no smoke and but little noise. When cartridges of this powder were fired from a Martini-Henry rifle, or 12-bore double-barreled fowling piece, the recoil could not be felt, and the report was no louder than that of a percussion cap. The penetration with thirty grains equalled that of eighty-one grains of violent sporting powder. There was scarcely any perceptible fouling of the barrel and no deposition of solid refuse. *The Engineer* does not think, however, that we are yet warranted in adopting gun-cotton cartridges for use with bullets, and it holds that a very extensive series of firing trials should be successfully carried out before we use it.

The new dynamite differs from ordinary dynamite in its absorbent, which is said to take up six times its weight of nitroglycerine and hold it without exudation or oxidation, while it is itself an explosive. The ingredients are at present a secret, but specimens of the new dynamite and of Nobel's were shown in water. The latter had exuded nitroglycerine, while in the former there were no signs of it. It is claimed, also, that the freezing-point of the new dynamite is lower than that of Nobel.

Experiments were made with gun-cotton to show its use as a military explosive, and ¼-ounce charges of gunpowder, Nobel's dynamite, the new dynamite, mining gun-cotton (a nitrated cotton), and pure gun-cotton (known as torpedo cotton), were tested by Colladon's* lead-cylinder test and the steel disk test, the results being about in the order given. Eighty steel rails were broken by detonating seven

* Proceedings Nav. Inst., Vol. V, p. 25.

ounces of dry cotton, with one ounce of dry cotton used as a primer. A tree was cut in two by a ring of gun-cotton pellets placed round it. Lastly, a weight of two hundredweight was dropped ten feet on a box containing five pounds of dry gun-cotton pellets without firing any of them. The cotton, which was crushed and broken by the fall, was proved to be dry by the ignition of some pellets by a match, when they readily burnt.

The steel-disk test is illustrated by drawings in *The Engineer.* It consists of a steel cylinder two inches in diameter, with walls one-fourth inch thick, in which a shoulder is cut at the top for the support of the steel disk, which is one-fourth inch in thickness. The explosive is placed on the disk and exploded, and it bends the plate into a cup of different depths, or breaks it, according to its strength. With twenty grams of new dynamite, or twenty grams of mining gun-cotton, holes were punched through these ¼-inch disks. Holes of small size were also punched through steel plates five-eighths inch thick with seven ounces of the new dynamite, and through steel plates fifteen-sixteenths inch thick with 14 ounces of the same material. The effect on tough wrought iron would probably be slightly less, but some of these experiments suggest punching plates with fulminate of silver or other such severe explosives, instead of by machine.

In speaking of the gun-cotton powder, *Engineering* says: "The absence of recoil can only be accounted for on the supposition that the charge burns slowly and progressively, thus maintaining a pretty uniform pressure throughout the whole length of the barrel." This explanation is warmly contested in letters to this journal of December 9 and 23, 1881, and January 20, 1882. *The Engineer*, speaking on the same subject, says: "The absence of smoke is an advantage justly claimed for gun-cotton. The decrease in noise is very well as far as it goes, but the absence of recoil is a more questionable matter, implying that the work done on the piece is more local and sudden, and therefore more dangerous to the piece. At the Royal Arsenal, in testing gun-cotton some years ago, as the conditions became more satisfactory, a recoil was produced."

On this subject W. T. Reid, the chemist to the works, in a letter to *The Engineer*, December 16, 1881, says: "You remark with reference to the new sporting-powder, 'The absence of recoil is a much more questionable matter, implying that the work done on the piece is more local and sudden, and therefore more dangerous to the piece.'

As the inventor of the powder, I should like to add a few words on this important subject of recoil. The method usually adopted for measuring the recoil of small-arms is to fix the gun or rifle in a frame provided with an apparatus for registering the recoil of the whole weapon. This method is, for the reason you have given, defective, and the results necessarily erroneous, as a charge of gun-cotton, dynamite, or other powerful explosive sufficient to burst the barrel might be detonated in it without producing more recoil than ordinary black powder. To obviate this difficulty, we now always estimate the recoil by means of a machine in which the pressure at the base of the cartridge itself is registered. Tested in this way I have found that the strain on the base of the cartridge, and consequently on the breech of the gun, is, in the case of the new powder, about one-quarter of that exerted by ordinary black sporting-powder, while the penetration at fifty yards in each case is the same. It appears from this that the powder required to propel the shot at the velocity produced by the usual charge of black powder need not necessarily cause the same strain on the breech of the gun.

"It may interest some of your readers to know the method we have adopted to secure the penetration of the shot from ordinary sporting-guns. Refined paraffine wax, of a definite melting-point, is cast into a block about two inches thick, and the penetration of the shot into this block is measured. The paraffine is kept at a uniform temperature of 54° F. by means of the water from the artesian well. This method has the additional advantage of permitting the recovery of the shot intact, their shape being to some extent an indication of the intensity of the explosion. When fired with dynamite or pure gun-cotton, for instance, the shot lose their spherical shape and are converted into polygons, which can be recovered uninjured by melting and pouring off the paraffine."

The Stowmarket Explosives Company has now become the Explosives Company, Limited, and has acquired 150 acres of land at Pembrey, near Swansea, where it will manufacture its nitroglycerine and gun-cotton compounds.

The rapidity of inflammation and combustion and of the transmission of detonation in explosives is a subject of great interest and practical importance, which has been but little studied for other

explosives than gunpowder. Abel has measured the rate of transmission of detonation for wet and dry gun-cotton, and Bunsen estimated the same constant for certain gaseous mixtures. The gaseous state seems to offer the best facilities for the study of this phenomenon, and the matter has been taken up in this form by Berthelot and Vieille, who have presented their results in a series of articles in the *Comptes Rendus*. These are entitled "On the velocity of the propagation of explosive phenomena in gases," XCIII, p. 18, and XCIV, p. 101; "On the explosive wave," XCIV, p. 149. The experiments were made by filling an iron tube, 8 mm. in internal diameter, with the gas, and exploding it at one end by means of a small electric spark. At accurately measured intervals in the tube diaphragms of thin tin were placed and connected with a Le Boulengé chronograph. To the tin were fixed small masses of fulminating mercury or picrate of potash, which were exploded by the wave, destroying the tin and breaking the current. About .01 of the gram of fulminate, or .006 of a gram of picrate, was used. The latter was employed because it is quite insensitive to a blow, is totally insensible to sonorous vibrations, and does not ignite below a temperature of 300°. The results were the same with both. The mixtures used were H and O, and CO and O, two volumes of the first to one of the second being taken in each case. In the earlier experiments the tube was but five metres in length, but as the velocity was found to be so great that the error of observation became very large, a tube over 40 metres in length was used. With this instrument it was found that the velocity of propagation in a mixture of H and O was 2810 metres per second, and in CO and O 1089 metres per second. A large series of experiments led to the conclusion that the velocity was independent of the position of the tube, of the material of which the tube was made, of the condition of the tube as to its being open at one end or both ends or closed at both ends, of the length of the tube, and of the pressure, but that the addition of an inert gas retarded the propagation. The fact that the flame was retarded by condensing water while the wave was still propagated, illustrates the difference between progressive combustion of a gaseous mixture and of detonation. Berthelot holds that these experiments reveal the existence of a new species of undulatory movement, of a mixed order, which is produced in virtue of a certain concordance of physical and chemical impulses developed through the transformation of matter. In a word, it does not act like a sound wave, transmitted from particle to particle with a velocity determined

only by the physical consttiution of the vibrating medium—a velocity which is the same for all vibrations. On the contrary, it is the change of chemical constitution which propagates the wave. The velocity of the explosive wave is also entirely different from that of the sound wave in the same medium. While the velocity of sound in the mixture of H and O is 514 metres at 0°, that of the explosive wave is 2841 metres. The velocity of sound in the CO and O is 328 metres, and in the CO_2 produced 264 metres, while the velocity of the explosive wave is 1089 metres.

It is difficult to establish the theoretical relation which ought to exist between the velocity of the explosive wave and the chemical nature of the gas which transmits it, as this depends upon the temperature, and it is not the same in the combustion of the two different systems. The inequality of temperature results from the great difference in the total heat (that for $CO+O$ being 68,200 and for H_2+O 59,000, supposing the water in the gaseous state), and besides, we are uncertain both as to the specific heat of these high temperatures and to the condition of the gas as regards dissociation. However, we may partially comprehend the theoretical relation governing the velocity of the explosive wave, if we observe that the total energy of the gas at the moment of explosion depends on the initial temperature and the heat disengaged during the combination; these two being given, we can determine the absolute temperature of the system, which is elsewhere proportional to the energy of translation of the gaseous molecules. Using Clausius' well-known formula,

$$v = 29.354 \text{ metres } \sqrt{\frac{\tau}{\rho}}$$

and letting τ, the absolute temperature, equal 3000°, Berthelot finds that the velocity of translation of the gaseous molecules, at the temperature of the experiment, would be practically the same as the velocity of the propagation of the wave measured in the experiments. [Notes on these papers will be found in *The Engineer* for Feb. 10, March 8, April 7, and May 19, 1882, and July 29, 1881.]

About the time that Berthelot undertook this work, Messrs. Mallard and Le Chatelier entered independently on a similar investigation, the results of which are given in the *Comptes Rendus*, XCIII, p. 145, under the title, "On the velocity of propagation of the inflammation in mixtures of explosive gases." The apparatus employed differed from Berthelot's, in having a small lateral tube attached to each

end of the main tube. The ends of these lateral tubes were closed by a membrane, on which an index rested. When the detonation took place the membranes were stretched and the index moved. They worked with mixtures of the detonating gases with other gases, and of course got lower results than Berthelot obtained in the molecular mixture. The one exception was a mixture of $CO+O$, when they obtained the singularly low velocity of 2.2 metres. Again, they worked with very short tubes, the longest one cited being 1.35 metres long. They hold that the velocity of propagation is greater when the gas is ignited at the closed end of the tube than when it is fired at the open end, and conclude that this is due to the enormous expansion of the products of combustion. They hold also that the velocity increases as the flame advances, that the velocity increases with the temperature, and that the diameter of the tube has no influence on the velocity except in exceedingly small tubes.

In pursuance of his investigations in thermo-chemistry, Berthelot has taken up the subject of the detonation of endothermic substances, and gives some of the results in the *Comptes Rendus*, XCIII, 613, under the title, "The detonation of acetylene, cyanogen and endothermic substances in general." Although neither acetylene, cyanogen nor nitric oxide can be detonated by simple heating, contact with a flame, or the electric spark, yet it was found that the detonation of a small quantity of fulminate of mercury would instantly detonate them. The study of explosive matters presents analogous phenomena, for while with dynamite, for instance, simple inflammation is insufficient to provoke detonation, this is effected under the influence of special detonators, like fulminate of mercury, which gives rise to a very violent blow. This is due, as shown above, to the development of an explosive wave. Berthelot holds that the superiority of fulminating mercury as a detonator is not due solely to the rapidity of its decomposition, but is due in a great measure to the enormous pressure which it devolops in detonating; a pressure greater than that of any known body, and which he estimates, from his experiments, to be equal to 40,000 kg. per square centimetre.

Endothermic substances may be exploded by a blow at the ordinary temperature if the volume is sufficiently reduced, as in the case or nitric oxide and oxygen, which exploded by a blow after its volume had been reduced to $\frac{1}{500}$ of its original volume, and then evolved 20,300 units of heat. As the temperature rises they become more

sensitive to blows, and hence it has been observed several times that celluloid, which is ordinarily a very stable body, has exploded when it has been struck a blow after it was heated to the temperature at which it could be moulded.

The new study, known as thermo-chemistry, is one with which the student of explosives must become familiar. It has been developed during the past twelve years through the independent labors of Thomsen of Copenhagen, and Berthelot of Paris. Until three years ago the only information to be obtained on the subject was through reading the numerous papers of these investigators and their pupils scattered through various scientific journals. In his "Essai de Mécanique Chimique fondée sur la Thermo-chemie" (Paris, 1879, 2 vols.), Berthelot has gathered together, in a systematic form, the fruits of his labors up to the time of publication. The subject has been ably reviewed by Prof. J. P. Cooke (*Am. Jour. Science*, XIX, 261), and the same author has given a resumé of the subject, with its application to explosives, in the recent edition of his "Chemical Philosophy" (1881).

To put it briefly, thermo-chemistry is the study of the thermal changes which accompany chemical changes. One of the simplest illustrations of this is found in the ordinary processes of combustion. When the atoms unite in these cases heat is evolved. It was for a long time generally believed that heat was evolved in all cases of chemical union, but we now know of many such cases which are attended by the absorption of heat. Owing to this fact chemical compounds have been divided into two classes, exothermous bodies, or those which evolve heat during their formation, and endothermous bodies, or those which absorb heat during their formation. One of the most remarkable compounds of the latter class is the chloride of nitrogen, which evolves 38,100 units of heat when it is decomposed. Another is nitric oxide.

This last substance has been made the subject of a recent investigation by Berthelot, in a contribution to the *Comptes Rendus*, XCIII, 668, under the title, "Nitric oxide as a supporter of combustion." Since nitric oxide contains more than ·50 per cent. of oxygen, and since this oxygen in combustion disengages 21,600 more units of heat than free oxygen, it ought to be a more active supporter of combustion than free oxygen. It is known in practice, however, that the temperature of the combustible must be raised very high before the

reaction takes place. Berthelot finds this to be due to the formation of nitric peroxide, which is only decomposed at a high temperature. The reason why the carbonic oxide developed from the mercuric fulminate (alluded to in the preceding paper) burns so suddenly in nitric oxide, is because the oxygen of the nitric oxide is set free all at once by the fulminate without passing through the stage of peroxide. (See also abstract in *Journal Chemical Society*, CCXXXII, 264.)

Under the title, "The heat of the formation of explosive substances," (*Comptes Rendus*, XCIII, pp. 213 and 269), Sarrau and Vieille describe their method of research and give some results. As the nature of the products varies with the pressure, they were obliged to analyze the products in each case, while measuring the heat developed. Knowing then the heat of formation of each of the products, they could calculate the heat of formation of the explosive used. The explosion was produced in a wrought-iron vessel of about 300 cm. capacity, immersed in a copper calorimeter containing 1.8 kilos of water. For nitroglycerine the heat of decomposition was found to be 1600 units of heat per kilogramme, when the reaction was

$$C_6H_5(NO_4)_3O_6 = 6CO_2 + 5HO + 3N + O,$$

and the heat of formation of one equivalent 94.

For nitromannite 1512 units per kilo. and the reaction

$$C_{12}H_8(NO_4)_6O_{12} = 12CO_2 + 8HO + 3N + 4O,$$

and the heat of formation for one equivalent 161.5.

For gun-cotton 1070.7 units per kilo. and the reaction

$$C_{48}H_{29}N_{11}O_{84} = 30CO + 18CO_2 + 11H + 11N + 18HO,$$

and the heat of formation for one equivalent 639.5.

For picrate of potash 2329 units per kilo. and the reaction

$$C_{12}H_2K(NO_4)_3O_2 = 10CO_2 + KOHO.2CO_2 + HO + 3N,$$

and the heat of formation for one equivalent 117.5.

For picrate of ammonia, $C_{12}H_2(NH_4)(NO_4)_3O_2$, 2818 units per kilo., and the heat of formation of one equivalent 80.1.

Berthelot and Vieille contribute a paper to the *Comptes Rendus*, XCIII, p. 289, on "The heat of formation of potassic perchlorate," which they find to be —112.5 units of heat.

In the *Comptes Rendus* for May 10, 1880, Sarrau and Vieille have given the results of their investigations upon the nature and volume

of the gas formed by the explosion of different explosives in closed vessels, and they have pointed out for gun-cotton that the reaction which attends the deflagration and the mean density of the products vary when increasing weights of the material are deflagrated in the same closed vessel. They have extended their researches to picrate of potash, and give the results in the *Comptes Rendus*, XCIII, No. 2, under the title "Experimental researches on the decomposition of picrate of potash; analysis of the products." The same general result is shown here as in the case of gun-cotton. The composition and volume of the gas, under normal conditions, with different charges, is given in the following table:

Mean density of products,	.023	0.3	0.5
Hydrocyanic acid (cyanide of ammonia),	1.98	0.32	0.31
Carbonic acid,	10.56	13.37	20.48
Carbon protoxide,	62.10	59.42	50.88
Marsh gas,	0.17	2.38	5.39
Hydrogen, (?)	10.31	6.77	2.68
Nitrogen,	16.88	17.74	18.26
Volume of gas in litres,	574.1	557.9	

We observe from this table that, as in the case of gun-cotton, the transformation from carbon protoxide to carbonic acid, under increased pressure, depends upon the vapor of water, but the hydrogen liberated passes into marsh gas. The experiments made with a density of 0.5 may be represented by the reaction,

$$8C_{12}H_2K(NO_4)_3O_2$$

$$= 2KCy + 6CO_2KO + 21CO_2 + 52CO + 22N + 3C_2H_4 + 4H + 7C;$$

but the numbers given above show a tendency to replace the three last terms by $4C_2H_4 + 5C$.

It has long been known that finely divided combustible powders suspended in air may produce explosions. This was pointed out in 1878, when an explosion in a flour mill in Minneapolis caused the explosion of another 25 feet distant, and this of a third at the same distance. (Report of Chief Engineer W. M. Brackett.) The cause of these explosions has been studied by Prof. S. F. Peckham, *American Journal Science*, XVI, 301.

The explosion in the Seaham colliery in September, 1880, drew attention anew to this subject, and Prof. Abel undertook the investigation of the question. For a notice of his report to the Home Secretary, see *The Engineer*, July 29, 1881 ; *Chemical News* 44, 16, 27, 39; or *American Chemical Journal*, 3, 298.

Abel used various powders in these experiments, and one of the most curious results obtained was that the most sensitive of the Seaham powders contained the least proportion of carbon, and more than one-half of its material was incombustible. The special experiments which were suggested by this observation showed that powders which are entirely incombustible, and are not susceptible of any chemical change through the action of flame, become very dangerous when brought in contact with a mixture of fire-damp and air. This effect seems to be attributable, at least in part, to the fact that the particles in passing through a flame become incandescent, so as to localize and increase the heat. One of the powders formed an explosive mixture in air containing only 2 per cent. of gas, and when a current of air was blowing with a velocity of only 5 decimetres per second, one and a half per cent. of gas was sufficient to make the mixture explosive. The coal dusts in mines not only develop and extend explosions, through their rapid inflammability and their disposition to remain suspended in currents of air, but they may also intervene as a means of propagating a flame rapidly as far as they extend, and rendering a proportion of fire-damp explosive which would not otherwise be dangerous.

A description of an explosion in a Nova Scotia coal mine, due to dust, is given in *American Journal of Science* [3] XXII, 18, and the subject of the explosions is discussed in the *Transactions of the North of England Institute of Mining and Mechanical Engineers*, XXXI, 127 and 145. *The Engineer* of September 14, 1881, gives an account of an explosion in a corn mill, and states that rice mills are still more dangerous. *The Engineer* of March 3, 1882, states that of 84 serious fires in mills since 1876, the origin of 56 was unknown.

In my lecture in these Proceedings on the Causes of Explosion, I have called attention to the work of Abel and of Champion and Pellet on the subject of communicated vibrations. Some fresh and interesting illustrations of the communication of sound vibrations to masses of matter can be found in a paper on Mill Floors, by C. J. H. Wood-

bury, in the *Transactions American Society of Mechanical Engineers*, 1882.

A. Girard gives an account of the preparation of hydrocellulose and its derivatives in the *Annales de Chimie et Physique* [5], 24, 337-384, and a note on the subject is found in the *Journal of the Chemical Society*, CCXXXIII, p. 378. Celluloid substances often undergo a remarkable modification in their physical state. Their flexibility and natural elasticity disappear, and they become brittle and easily reducible to powder. By the action of mineral and even vegetable acids, cellulose, $C_{12}H_{10}O_{10}$, before becoming saccharified, is transformed by hydration into a new compound, $C_{12}H_{11}O_{11}$, which the author terms hydrocellulose. It closely resembles cellulose, but differs from it by its extreme brittleness.

The methods of preparation may be divided into three general classes: 1. The immersion of the celluloid material in a powerful and concentrated acid. 2. The exposure of the material to acid vapors. 3. Methods dependent on the employment of weak acid solutions requiring a more or less prolonged contact, or a temperature above the normal one. The ultimate product is the same by either method whether cotton, flax, hemp, jute, paper, wood or elder pith is used.

Only the mineral acids have the power of transforming cellulose into hydrocellulose by simple immersion. The reaction proceeds most easily with sulphuric acid; it is less energetic with phosphoric acid. If sulphuric acid is employed its strength should be carefully determined, and the most convenient for use is of sp. gr. 1.453. The fibre is immersed in it at 15° and allowed to remain 12 hours. Hydrochloric acid, when used at 21° B, transforms the fibre into hydrocellulose in 24 hours. Hydriodic, hydrobromic and hydrofluoric acids behave in a similar manner in aqueous solutions. When nitric acid at 43° B. is employed, the product consists of a mixture of hydrocellulose and nitrocellulose: weaker acid fails to yield any considerable quantity of hydrocellulose. When cellulose is immersed in syrupy phosphoric acid it is only very slightly modified.

Cold, moist hydrochloric acid gas transforms cellulose into hydrocellulose in about an hour. When employed warm and moist, the reaction is complete in a few minutes. Girard states that the action of hydrochloric acid on cellulose has afforded him the means of establishing with certainty the nature of the phenomena resulting in the production of hydrocellulose. Hydrobromic and hydriodic acid resemble hydrochloric in their behavior.

Dilute solutions of sulphuric, hydrochloric, nitric and phosphoric acids (1 in 100 for example) when used to saturate cellulose, effect the transformation into hydrocellulose in from two to three months, if after immersion the fibre is left in the air at the ordinary temperature. The action is complete in one month when a 3 or 4 per cent. solution is employed. If, however, the solution is heated to 60°–70° a few hours is sufficient. A one per cent. solution of the acid, at the above temperature, renders the cellulose completely friable in a few hours. When the cellulose is immersed in a five per cent. solution of oxalic acid, dried in air and heated in closed vessels to 100°, the change is complete. When tartaric, citric, acetic and formic acids are used it is incomplete.

When the celluloid material, such as a fibre of cotton, is immersed in a strong solution of potash, it becomes swollen or "mercerised." It then possesses the property of becoming blue with iodine, like that treated with sulphuric acid. No hydrocellulose is formed, however, though the swollen fibre presents the same appearance under the microscope as that acted on by sulphuric acid.

Hydrocellulose, however it may be prepared, has always the same composition. It is a fine white powder, which oxidizes rapidly on application of heat or prolonged exposure to the air. Samples for analysis were always dried by the author in a vacuum, or in a current of some inert gas. It is to be regarded as a carbohydrate intermediate between cellulose and glucose. Its production is always accompanied by that of glucose, and in no case could Girard obtain the theoretical yield of hydrocellulose. Its production from cellulose is due to direct hydration, the necessity for the presence of water in the operation being direct proof thereof. Girard shows that the theory that the modification of celluloid substances by direct dehydration and carbonization is due to the dehydrating power of certain salts, ought not to be admitted, since it is to the direct action of acids liberated from these salts when in contact with vegetable matter that the phenomenon is due. It is only at relatively high temperatures and by a secondary action that carbonization takes place.

Hydrocellulose is characterized by its great friability. It differs from cellulose in the greater sensibility which it exhibits towards all reagents. It can best be distinguished from cellulose by the facility with which it is oxidized. When heated in sealed tubes at 180° with sulphuric acid (5 per cent.), cellulose dissolves completely in 8 to 10 hours, yielding a solution which is almost colorless, and evolving no

gas. Hydrocellulose also dissolves under the same circumstances, but leaves an abundant deposit of carbon, and on opening the tube there is a copious disengagement of gaseous products. Heated in sealed tubes with seven or eight times its weight of acetic anhydride, hydrocellulose dissolves instantly, as soon as the temperature reaches 180°, whilst two or three hours are required to dissolve cellulose. It is remarkable that dye-stuffs, which can be made to color cellulose only with great difficulty, possess a great affinity for hydrocellulose.

Cellulose and hydrocellulose yield identical nitro-compounds, and hence Girard concludes that the hydrocellulose is dehydrated before it is nitrated. It yields only the same amount of nitro-compound as cellulose. The yield of pyroxylin is greater when the hydrocellulose is not used in the form of powder.

Girard points out that the rotting of window-curtains in towns is probably due to the production of hydrocellulose by the action of hydrogen sulphide and sulphurous anhydride in the air. He also attributes the dry-rotting of wood to the production of the same substance by the action of acids generated by the fermentation of saccharine matter.

As nitric acid is extensively used in the manufacture of the high explosives, the dangers attending its transportation and storage should be pointed out. Owing to the burning of a car containing nitric acid at Baden, Prof. R. Haas of Carlsruhe made some experiments for the government, which proved that strong nitric acid may cause spontaneous combustion when it comes in contact with straw, paper, tow, and the like, in a confined space.—*The Engineer*, Dec. 9, 1881.

Van Nostrand's Magazine for April, 1882, gives a notice of a new magneto-electric exploder invented by Marcel Deprez.

Giornale d'Artiglieria é Genio (official), No. 2, p. 8, 1882, contains an illustrated article entitled "Instructions on the method of using gum dynamite for the destruction of shells which have failed to explode in firing."

In the *Mitt. u. Gegenstände d. Artillerie u. Genie-Wesens*, Part 7, 1881, Capt. Philip Hess gives the results of an elaborate series of experiments on the best material for the construction of magazines and laboratories for explosives. He abandons altogether the idea that

such buildings should be made very strong with thick walls, since an explosion cannot be confined, and as the falling fragments are a source of danger, the heavier they are the more harm will be done. The lightest material of which they can be made is wood, but this is inflammable, and the flying brands would be dangerous. For this reason sheet-metal has been used, but this is almost as dangerous as stone, and is also quite expensive, while in hot weather it becomes itself a source of danger in dynamite factories. A very safe roofing of asphalt has been used, but it deteriorates rapidly unless protected by sand, graval or cement, and these are only suitable for horizontal or slightly inclined surfaces. Asbestos pasteboard is an excellent material, being uninflammable, weather-proof, a bad conductor and good absorbent of heat, but it is very expensive. Since no suitable material was at hand, Capt. Hess instituted experiments upon materials for impregnating wood so as to render it uninflammable and impervious to the weather. Slabs of soft wood were coated with the material to be tested, submerged in water for fifteen minutes, rubbed with the hand, heated in a copper cylinder to a clear red glow, and then cooled. Its inflammability was tested by means of a jet blow-pipe. The best result was obtained by coating the wood with water-glass mixed with such substances as would form insoluble silicates on the surface. Compositions formed with lime or oxychloride of zinc proved excellent, but Portland cement brushed over water-glass gave even better results. When this last is used in dynamite factories it requires to be whitewashed when it has darkened from exposure. None of these preparations should be used on the interiors of magazines or laboratories, on account of the danger of friction from fallen particles. Capt. Hess thinks this research can be advantageously extended to other materials. To test for the power of resistance to frost, he wets the surface profusely and suddenly volatilizes the water by applying the blow-pipe flame. He finds the disintegrating force fairly corresponds to that of frost.

Engineering, of November 4, 1881, describes a hydraulic machine for making prismatic powder just constructed for the Waltham Abbey Factory. As the best pebble powder was found too variable in density, experiments were made in pressing prismatic powder with temporary presses, and excellent results were obtained with a grain two and three-eighths inches across, two inches deep and three-eighths inch hole. The new press can make thirty of these prisms

at each stroke, and the operations of filling, pressing and ejecting are performed in two and one-half minutes. The machine comes fully up to the favorable anticipations formed of it, and it is turning out twenty-five to thirty barrels per day of these large prisms of quite uniform density. The article is accompanied by a cut, which is necessary to a full description.

An illustrated report on the fatal explosion of gunpowder at the factory of Messrs. Wakefield, near Kendal, in July last, by Major Ford, R. A., states that this explosion, as well as two others in press-houses which have occurred since the Explosives Act has been in force, was brought about, not in the operation of pressing itself, but in processes incidental thereto. Press-boxes, which are liable to be the source of danger if friction arises in the press, seem quite unnecessary, and their use has been abandoned in four powder factories of the United Kingdom with satisfactory results. The men were able to spread the mill-cake more quickly and equally on the press-plates, and the plates were subsequently more easily separated.—*The Engineer*, October 7, 1881.

M. Dapremont sends to the *Comptes Rendus*, XCIII, 354, a note on the use of a new chlorate of potash powder.

The *Comptes Rendus*, February 6, 1882, in announcing the award of a prize of 3000 frs. to Lieutenant Colonel Sebert, of the Marine Artillery, reviews at length his work upon explosives and artillery, and refers to the various instruments of precision used in or invented for his experiments.

The Engineer, of September 9, 1881, devotes a leader to the loss of the Doterel, in which it states that the court-martial acquitted Commander Evans of all blame, and found the cause of the explosion in the ignition of coal-gas in a bunker, which, on explosion, exploded the magazine. Exception is taken to the explanation of the court as to the manner in which the explosive impulse was communicated to the magazine. Returning to the subject on January 20, 1881, after the loss of the Doterel, it says, "The news of the explosion on board the Triumph, off Coquimbo, has revived the doubts as to the general management of the Navy which the loss of the Doterel and the subsequent official inquiry had given rise to. We do not remember whether the drier which boasts of the barbarous name of '*xerotine*

siccative,' which means 'drier' twice over in Greek and in Latin, and to which the recent explosion is due, was mentioned in connection with the accident at Puntas Arenas. But in any case there appears to be little doubt the authorities saw cause for suspicion, and the drier, which had already been analyzed and pronounced harmless, was then analyzed again and pronounced to be of so doubtful a character that its use in the Royal Navy was to cease. Since the recent accident, directions have been forwarded to every station to the effect that it is to be regarded as a dangerous explosive, and should be got out of the way as quickly as possible. As far as concerns the Doterel, it is of course difficult to say that this '*siccative*' was the cause of the accident. But it will be remembered that the evidence showed the existence of dangerous communications with the magazine from various parts of the ship. If the explosion which killed three men and injured half a dozen others on board the Triumph had communicated itself to the magazine, the entire ship would have gone to the bottom. The class of compounds to which the name of '*siccative*' is given are varnishes which are added to oil paints to make them dry quickly. They are prepared by boiling linseed-oil with metallic oxides or salts. Formerly, litharge, minium, umber, and gypsum were employed for the purpose, but more recently the oxides and salts of manganese have come into use. They produce rapidly drying siccatives, and when added to zinc-white, do not introduce any substance that can be blackened by sulphuretted hydrogen. A mixture of equal parts of manganous sulphate and acetate with an equal quantity of zinc sulphate and ninety-seven parts of zinc-white, added in the proportion of one-half to one per cent. to the zinc oxide with which the oil color is to be prepared, is said to effect the drying of the paint in twelve hours. A similar mixture is the *siccative zumatique de Barruel*, which, according to Bolley, is made by mixing from five to six parts of borous manganate (?) with ninety-five parts of zinc-white, and adding to zinc-white colors in the proportion of about two and one-half per cent. Acetates and manganates closely associated with boiled oils do not form the most stable compounds imaginable. It now appears, from a letter which has been forwarded to the Admiralty by the commander-in-chief at Portsmouth, and written by three survivors of the Doterel explosion, including the carpenter, that they attribute the disaster in the Straits of Magellan to the ignition of xerotine siccative, and not to the explosion of gases generated in the coal-bunkers, as had been found by the court-martial upon the evidence of Professor Abel. The explosion on board the Triumph, they

state, directed their attention for the first time to the fact that xerotine siccative had explosive properties, and reminded them that within a very short time of the explosion, perhaps fifteen minutes, a leakage of xerotine siccative had been discovered in the paint store-room, which is immediately adjacent to the fore magazine, in which all powder stores, excepting small-arm ammunition, were placed. The presumption is that the escaped composition flowed under the wooden flat of the magazine, and that the inflammable vapor it gave off was ignited by the light carried by the man told off to clean the store-room floor. What remained of xerotine siccative in the cask had been in the meantime thrown overboard by the seamen who are still alive."

A New York chemical firm says that siccative is the trade-name of a concentrated drier to put in paint. It comes in two forms, dry and liquid. When dry it may be sugar of lead, borate of manganese, any of the grades of umber, or a variety of other substances. In the liquid shape it is simply the same substances with some liquid added to carry it. This liquid is generally alcohol, turpentine, or benzine. Benzine is the cheapest and most commonly used.

Under the somewhat misleading title of "Modern Explosives," Mr. B. V. Abbott calls attention to the many accidents caused by explosives, and shows the necessity for more stringent laws concerning their manufacture, transportation, storage, and use.—*Popular Science Monthly*, XX, 794.

The recent edition of the Encyclopædia Britannica devotes considerable space to the subjects of "Explosives" and "Gunpowder," by Major W. H. Wardell, of Waltham Abbey, and to "Gun Cotton," by Prof. Abel.

The best recent examples of the text-book, the hand-book, and the manual of explosives are to be found respectively in "Poudres de Guerre" of the "Ecole d'Application de l'Artillerie et du Génie," Böckmann's "Explosiven Stoffe," and Désortiaux' "Traité sur la Poudre et les Corps Explosifs." The first is simple in style, accurate in statement, well digested, and suitably arranged for study. The second forms one of the volumes of Hartleben's Chemisch-technische Bibliothek. It rapidly reviews the whole subject and briefly summarizes the results of recent experiments, while it contains a large number

of references to the original papers, and thus serves as a useful index to recent literature. The "Traité sur la Poudre" is a translation, in two volumes, from the German of Upmann and Meyer, but it is greatly augmented. It is published by Dunod.

Gauthier-Villars announce a new serial, under the name "Memorial des Poudres et Salpêtres," which is to be published by the French government. It will appear in two numbers, of from two hundred to four hundred pages each, yearly, at five francs per year. Only officers of the army and navy and government engineers are permitted to subscribe. Each volume will be divided into three parts, containing, 1st. Technical documents; 2d, Administrative documents; 3d, Bulletins of experiments and bibliography.

PROFESSIONAL NOTES.

ON THE LENGTH OF A NAUTICAL MILE.

By J. E. Hilgard,

Superintendent U. S. Coast Survey.

[*Transcript from U. S. Coast Survey Report for* 1881.]

The length of a nautical mile is defined as the one-sixtieth part of that of a degree of a great circle of the earth. If the earth were a perfect sphere of known dimensions, the length of a nautical mile, according to the above definition, would be a definite and invariable quantity.

Owing, however, to the earth's compression, and the consequent difference in the lengths of the radii of curvature at different points of its surface, much diversity has arisen, in usage and in books of reference, in assigning the length of a nautical mile.

Thus it is variously given as equal to—

The mean length of a minute of latitude on the meridian.

The length of a minute of the meridian, corresponding to the radius of curvature of the particular latitude.

The length of a minute of longitude on the equator. The latter definition being probably due to the common use, among mariners, of Mercator's projection, in which the degrees of the successive parallels of latitude are equal to those on the equator.

In order to remove all uncertainty, and to introduce uniformity, this office adopted, several years ago, the value which results from considering the nautical mile as equal to *the one-sixtieth part of the length of a degree on the great circle of a sphere whose surface is equal to the surface of the earth.* This value, computed on Clarke's spheroid, is: One nautical mile = 1853.248 meters = 6080.27 feet, a value which corresponds to the adopted length of the Admiralty knot = 6080. feet.

In the following tables are given the numerical results of the discussion relating to this subject:

Figure of the earth from Clarke's combination of geodesic measures.

Equatorial radius, $a = 6378206^{m.}$ [6.8046985]   Polar radius, $b = 6356584^{m.}$ [6.8032238]

$$\text{and } \frac{b}{a} = \frac{263.98}{294.98}, \qquad c = \frac{1}{294.98}$$

1. *Length of* 1′ *on the equator:*

$$\begin{array}{ll} \log a & 6.8046985 \\ \log 1' & 6.4637261 \\ \hline & 3.2684246 \end{array}$$

$$\text{Length of } 1' = 1855\overset{m.}{.}345 = 6087\overset{feet.}{.}15$$

2. *Length of* 1′ *of latitude at the equator:*

$$\text{Radius of curvature} = \frac{b^2}{a}$$

$$\begin{array}{ll} \log b^2 & 3.6064476 \\ \log a & 6.8046985 \\ \hline \log \frac{b^2}{a} & 6.8017491 \\ \log 1' & 6.4637261 \\ \hline \log & 3.2654752 \end{array}$$

$$\text{Length of } 1' = 1842\overset{m.}{.}787 = 6045\overset{feet.}{.}950$$

3. *Length of* 1′ *of latitude at the poles:*

$$\text{Radius of curvature} = \frac{a^2}{b}$$

$$\begin{array}{ll} \log a^2 & 3.6093970 \\ \log b & 6.8032238 \\ \hline \log \frac{a^2}{b} & 6.8061732 \\ \log 1' & 6.4637261 \\ \hline & 3.2698993 \end{array}$$

$$\text{Length of } 1' = 1861\overset{m.}{.}655 = 6107\overset{feet.}{.}85$$

4. *Length of* 1′ *on the meridian in latitude* 45°:

$$\text{Radius of curvature} = \tfrac{1}{2}(a + b) - \tfrac{7}{8}ac^2$$

$$\begin{array}{ll} \log \tfrac{1}{2}(a + b) & 6.8039618 \\ \log 1' & 6.4637261 \\ \hline & 3.2676879 \end{array}$$

$$\begin{array}{ll} \log a & 6.8047 \\ \log c^2 & 5.0604 \\ \log 1' & 6.4637 \\ \hline & 8.3288 \end{array} \qquad \begin{array}{r} 1852.200 \\ -\frac{7}{8}\times 0.0213 = -\ 0.019 \\ \hline \text{Length of } 1' = \overset{m.}{1852.181} = \overset{feet.}{6076.76} \end{array}$$

$$ac^2 \times 1' = 0.0213$$

5. *Length of a quadrant of the meridian:*

$$\text{Length of quadrant} = \tfrac{1}{4}\pi(a+b)\left\{1+\tfrac{1}{4}\left(\frac{a-b}{a+b}\right)^2+\frac{1}{64}\left(\frac{a-b}{a+b}\right)^4+\ldots\right\}$$

$$\tfrac{1}{4}\left(\frac{a-b}{a+b}\right)^2=\tfrac{1}{4}\left(\frac{1}{588.76}\right)^2=0.0000007,\quad \log.\ \tfrac{1}{4}(a+b)\ \ 6.5029318$$

$$\begin{array}{lr} \log \pi & 0.4971499 \\ \log 1.0000007 & 0.0000003 \\ \hline & 7.0000820 \end{array}$$

Length of a quadrant of the meridian $= 10001888^{m.}$

6. *Length of* 1′ *on the surface of a sphere whose radius* $= \frac{1}{2}(a+b)$:

$$R = \tfrac{1}{2}(a+b) = 6367395^{m.} \qquad \begin{array}{lr} \log = & 6.8039618 \\ \log 1' & 6.4637261 \\ \hline & 3.2676879 \end{array}$$

$$\text{Length of } 1' = \overset{m.}{1852.200} = \overset{feet.}{6076.82}$$

7. *Length of* 1′ *on a sphere, the radius of which is equal to the average radius of curvature of the meridian, the radii of curvature being at equal angular intervals:*

$$R = \tfrac{1}{2}(a+b)+\tfrac{1}{16}ac^2 \qquad \begin{array}{r} \overset{m.}{1852.200} \\ +\tfrac{1}{16}\times 0.213\ \ +0.001 \\ \hline \text{Length of } 1' = 1852.201 = \overset{feet.}{6076.82} \end{array}$$

This is identical with the length of a quadrant of the meridian divided by 5400.

8. *Length of* 1′ *on the surface of a sphere, the area of a great circle of which is equal to the area of the plane of the meridian of the spheroid:*

$$R = \sqrt{ab} = \tfrac{1}{2}(a+b)-\tfrac{1}{8}ac^2 \qquad \begin{array}{r} 1852.200 \\ -\tfrac{1}{8}\times 0.0213 = -\ 0.003 \\ \hline \text{Length of } 1' = 1852.197 = \overset{feet.}{6076.82} \end{array}$$

9. *Length of* 1′ *on a sphere, the surface of which is equal to the surface of the earth:*

$$R = \tfrac{1}{3}(2a+b) - \tfrac{1}{45}ac^2, \ \tfrac{1}{3}(2a+b) = 6370999 \quad \log \ 6.8042075$$

$$\log 1' \ 6.4637261$$

$$[\tfrac{1}{45} + \times 0.0213 = 0.0004] \qquad 3.2679336$$

$$\text{Length of } 1' = \overset{m.}{1853.248} = \overset{feet.}{6080.27}$$

10. *Length of* 1′ *on a sphere, the volume of which is equal to the volume of the earth:*

$$R = \sqrt[3]{a^2 b} = \tfrac{1}{3}(2a+b) - \tfrac{1}{9}ac^2 \qquad \overset{m.}{1853.248}$$

$$-\tfrac{1}{9} \times 0.0213 \ -0.002$$

$$\text{Length of } 1' = 1853.246 = \overset{feet.}{6080.26}$$

Recapitulation.

	Meters.	Feet.
Length of 1′ on the equator	1855.345	6087.15
Length of 1′ of latitude at the equator	1842.787	6045.95
Length of 1′ of latitude at the pole	1861.655	6107.85
Length of 1′ of latitude for latitude 45°	1852.181	6076.76
Length of 1′ *on the surface of a sphere.*		
Radius equal to the mean of the semi-axes of the earth	1852.200	6076.82
Area of a great circle equal to area of plane of meridian of the earth	1852.197	6076.82
Radius equal to average radius of curvature of meridian of the earth	1852.201	6076.82
Surface equal to the surface of the earth	1853.248	6080.26
Volume equal to the volume of the earth	1853.246	6080.26

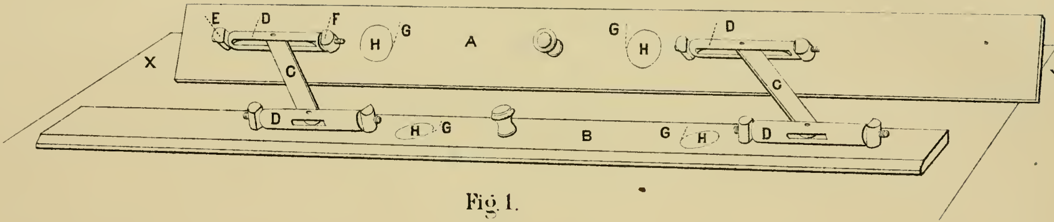

Fig. 1.

Fig. 2.

Fig. 3.

SIGSBEE'S PARALLEL RULE.

SIGSBEE'S IMPROVED PARALLEL RULE.

The accompanying plate is copied from a photograph of the rule, and represents a perspective view, in which the broad surfaces of the blades are inclined to each other, while the blades remain parallel.

The blades A and B are connected by the radial links C, C, the latter being pivoted in slotways in the rotating bars D, D. The rotating bars are pivoted at each of their ends by means of cone-pointed steel screws, to the studs E, F, &c., let into the blades. Each stud is slotted (slots not shown in the plate) down to the screw-hole for the pivot, so that by pinching the stud before the pivot is inserted the latter will have a tight fit within the stud. Each blade is perforated by two holes, G, G, into which are inserted rubber buttons or pads, H, H, to be pressed by the thumb and finger. Fig. 2 is a section showing a button in its normal state. Fig. 3 shows the button in the shape it would take when pressed.

This rule, which is simply the old rule improved, is intended to afford greater facility of use on the ordinary cabin table or desk, the surface of which is often found to be warped or uneven.

Substitutes have been offered for the old parallel rule from time to time, but navigators still cling to that time-honored instrument, notwithstanding its tendency to slip, to bind in action, and to come to a halt at a tear in the edge of a chart. While bearing in mind this conservative fondness for the old rule, the writer yet ventured to submit the improved rule to nautical judgment, hoping that, by reason of its similarity to the former in pattern and method of use, its special advantages would receive attention and perhaps approval. The decided preference since shown for the improved rule by naval officers and others, as expressed verbally and in official reports, has led to its adoption in the naval service and other branches of the government.

In the old rule movement of the blades is restricted to a single plane parallel to the surface upon which the fixed blade rests. By forcing the moving blade out of that plane, which is done when using the rule on warped surfaces, the fixed blade is disturbed and the initial parallelism of movement destroyed, or such a severe strain is brought upon the pivots that they will rapidly wear away until no longer true. However handy, therefore, the old rule may be, as compared with other instruments, it is, nevertheless, inherently faulty for the use to which it must sometimes be put.

In the new rule the radial links are jointed at their ends, so that at any point in the swing of the moving blade the latter may be lifted from the working plane without breaking parallelism; in fact, it may be carried completely over the fixed blade in a semicircle. At first glance it might appear that by increasing the *sources* of error in the introduction of additional pivots, the new rule is made to sacrifice accuracy to convenience, but it is soon seen that the lifting action of the moving blade almost entirely relieves the pivots from wearing strain, and that the pivots should therefore remain true a much longer time than those of the old rule. The pivots of the new rule being adjustable, wear may be taken up by the simple method of readjustment described herein.

A critical moment in the use of the old rule is when the blades come in contact. The links then rest wholly upon the blades, and if the pivots are true the links must bind upon the blades unless the latter are resting upon a perfectly true surface. It is, in fact, often the case that the old rule closes only at one end. When this happens the blades should be brought into continuous contact without shock, particularly if they are heavy.

The principal advantages of the improved rule are as follows:

1. Ease of movement, due to the method of hinging the blades.

2. The blades may be raised over thumb-tacks, creases or torn edges of charts; and are self-lifting when moved over uneven surfaces of tables, thus reducing the probability of slipping.

3. In projecting a course, if it be desired to examine, for soundings or shoals, that part of the chart covered by the rule, the moving blade may be thrown back for that purpose without shifting the other blade; or it may be stood on edge along the projected course, rendering pencil lines unnecessary.

4. A slight pressure with the thumb and finger on the two rubber buttons of the fixed blade will tend to prevent the rule from slipping.

5. A parallel to the edge of a drawing board or block may be drawn by placing the blades at right angles to each other; one blade flat upon the paper and the other flat against the edge of the board or block.

6. The entire length of the inner edges of the blades may be used for ruling, without interference from the links, by throwing back the moving blade until it rests upon the hand which holds the fixed blade.

It is nicely adjusted to parallelism by the manufacturer, but should the pivots loosen in use, which is not likely to occur as they are now made, the readjustment may readily be restored; thus: Set up all the pivot screws to their seats without binding; then adjust for parallelism by moving a single rotating bar, that between the studs E and F, for instance. When the blades are brought together, if they are in contact at the end Y, loosen the pivot screw at E slightly and advance that at F correspondingly, moving the rotating bar in the direction F to E. If, on the contrary, the blades are found in contact only at the end X, the same bar may be moved in the direction E to F, until the end Y is closed.

C. D. SIGSBEE,
Commander U. S. N.

HOGG'S SPEED INDICATOR.

U. S. S. Jamestown, 3rd Rate,
At Sea, Lat. 38° N., Long. 71° W.,
June 21, 1882.

Sir:

In obedience to your order of April 15th, we have examined the "Speed Indicator" invented by Ensign W. S. Hogg, U. S. N., noting its performance under all circumstances of wind and sea, and report as follows:

In a smooth sea, and with a speed of three (3) knots and over, it works admirably. With a speed of two and one-half (2½) knots or less, the instrument does not float sufficiently near the surface to record accurately. This defect

might be remedied by construction of a lighter material, so that it would work at a much smaller speed, and the inventor thinks he can accomplish this quite easily.

It is accurate for all speeds of three (3) knots and over. In a moderate sea, the pitching or rolling of the ship causes the indicator to fluctuate slightly, though not to seriously affect its reading; and with heavy pitching or rolling, this fluctuation is increased but very little. In either case it is much easier to read it to one-tenth of a knot than it is to read the mercurial barometer under similar circumstances. Its advantages over the common log are: It records constantly and tells at a glance the speed of the ship when going three (3) knots or over, and thus enables the officer of the deck to judge accurately of the run for the hour; it requires no one to manipulate it; it can register the speed in several places at the same time; it shows immediately the effect of making or reducing sail; self-registering logs show how far the ship has run in a certain time, but this tells how fast she is going at any instant. Should it become fouled by sea-weed or other substances, an accident likely to happen to all other logs, it can be readily cleared by simply hauling it in, and is then ready for use again. There is no machinery about this instrument, thus enabling any one to use it.

We have had no opportunity for observing the working of the Indicator for a greater speed than ten and one-half (10½) knots.

In our opinion, the "speed indicator" will prove a very great addition to the comforts of navigation in both the navy and mercantile marine, and we would recommend its adoption in the service.

These observations were made in a passage from San Francisco around the Horn to Newport, a distance of over fifteen thousand (15,000) miles, and covering a period of nearly four months.

Very respectfully, your obedient servants,

Geo. W. Pigman, Lieut. Comd'r., U. S. N.
J. W. Miller, Lieutenant, U. S. N.
John M. Hawley, Lieutenant, U. S. N.

Commander A. D. Brown, U. S. N.
Commanding U. S. S. Jamestown.

RESOLUTIONS ADOPTED BY THE INTERNATIONAL MEDICAL CONGRESS, LONDON, 1881.

Tests of Sight suitable to be enforced in the case of Signallers and Look-out Men, and other persons by Land or Sea.

(2) That in *ocean-going ships* and in *all steamers*, especially those carrying passengers, there should always be in actual control of the helm a person possessing *with the two eyes together*, *without glasses*, normal sight, both as to acuity and colors; and that, *in addition*, in such ships, *at least one* of the persons actually on the look-out should be similarly qualified.

(3) That, in vessels engaged in the coasting trade, every person liable to take charge of the helm should possess *with the two eyes together*, *without glasses*, sight equal to at least two-thirds of the normal, both as to acuity and colors.

(4) That all persons engaged in marine signalling, ashore or afloat, and all pilots, should have normal sight, both as to acuity and colors, as defined in Article 2.

(5) That hypermetropic persons, although satisfying the requirements of Articles 2, 3, and 4, should, nevertheless, not be admitted, if before the age of eighteen they have a manifest hypermetropia of one dioptre.

(6) That re-examination should be made at the age of forty-five.

(7) That the examinations should be conducted by persons of recognized competency, under the direction of a Central Medical authority in each country.

8. That an international commission should be constituted, to fix upon such further measures as to signals as may be necessary for safe navigation, and, specially, upon the standard colors, and the sizes of the signals employed.

It is obvious that regulations having an international character become every year more urgently required from the increasing number, size, and speed of vessels.

In view of the practical difficulties with which all compulsory examinations are attended, it has been sought,—

(*a*) To limit the examination in each case to what is strictly necessary.

(*b*) To require them only when absolutely indispensable, and of the smallest possible number of persons.

(*c*) To simplify the methods as much as possible.

On large ships, many sailors not required for the helm, or to be responsible for the look-out, may be admitted without certificate of examination ; but as it will be in the interest of all to be possessed of such a certificate, which would represent a higher competency, it may be expected that many would themselves seek for it, from whom it would not necessarily be demanded ; and facilities for obtaining it should at all times be at hand in maritime ports.

(2) Good sight *without the aid of* glasses is required, because glasses fail to help just where clear sight is most needed, *e. g.*, in storm, rain or fog.

Acuity of Sight.—Complete acuity is not more than sufficient, and even scarcely sufficient, having regard to the increasing number, size and speed of steamers. But it will be practically enough if at sea this complete acuity is attained by the use of *both eyes combined.* The number of persons excluded under this rule will be much less than if complete acuity for *each eye separately* is exacted.

The acuity is supposed to be determined by viewing letters or signs at a certain distance, under a certain angle, on the principle of the test-types of Snellen.

Color Sense is supposed to be tested by pseudo-isochromatic tables, on the principle of those of Stilling, subject to control by the use of light transmitted through colored glass, in imitation of signal lights. This control will also aid in detecting central scotoma for colors, in the very rare cases where it might co-exist with the required acuity.

Holmgren's excellent tests have been already extensively adopted. But their use demands more skill in the examiner. Tests well selected on the

principle of Stilling might be very well adopted as standards for ascertaining normal color sense, as well as definite degrees of color sense below the normal. The principle of Stilling has been recommended as affording a quantitative as well as a rapid qualitative test.

(3) A lower standard is fixed in the coasting trade (excluding steamers), because the vessels are smaller and the speed less. Moreover, a demand for full acuity would render it difficult to procure a sufficient number of sailors ; as each hand must be liable in small vessels to serve at the helm.

(4) It is obvious that the persons here named must have full acuity and color sense.

(5) Persons having a manifest hypermetropia above that here indicated would not possess at the age of thirty-five or forty, without glasses, the needful degree of acuity: it is better, then, both for themselves and the service, that they should not be admitted at all.

(6) The attendant practical difficulties have caused one re-examination only to be advised at the age of forty-five. It has been found that the very great majority of persons, once admitted as having good sight, have retained it up to that age. A great number, no doubt, have been admitted hitherto without sufficient examination. Still, it would not be practicable to institute a general examination of those already in the service. Nevertheless, it would be desirable to examine anew, in the case of passenger-steamers, all those responsible as helmsmen and look-out men.

The Congress recommends that surgeons of ships should be qualified to exercise special surveillance as to the sight of those employed in these capacities on board.

(7) A central medical authority is requisite to insure the perfection of the system and its uniformity. He should propose the examiners, and be responsible for their fitness. They should be men of ascertained competency, and, as far as practicable, qualified as medical specialists.

(8) The measures recommended in Articles 2 to 7 should be brought into operation without delay. But an international commission would still have to determine the precise color of the glass, securing uniformity in that as well as in the size and disposition of the signal lights.

The Congress lay the greatest stress upon the appointment of this commission in respect of marine signalling, as quite indispensable for the attainment of the object in view. The commission would have to inquire into, and decide upon, many matters on which information is at present incomplete, and regarding which only a few points have been touched upon in Article 8.

Every government, especially the maritime governments, should be requested to place one or more members on the commission, and chiefly experienced naval officers and medical specialists.

It is understood that this question of an international commission is about to be submitted to the Legislature of the United States of America, supported by a petition largely signed by scientific men of that country.

The resolutions emanated from the Ophthalmological Section of the Congress, and were drawn up, in the first place, by a committee representing twelve different countries.

THE GARDNER GUN.

In *Engineering* for June 2d, particulars are given of this gun, together with the report of the committee appointed to test the various machine guns for naval service. As a result of the report made, the Admiralty have ordered 250 Gardner guns. The report is quite comprehensive, but its finding is the only point of importance, the experiments being of the same general character that have been conducted elsewhere.

The report states—" The Gardner system appears to the committee to possess the following advantages, viz.

1. Simplicity of mechanism.
2. Facility of removing and accessibility of parts.
3. Strength and endurance.
4. Rapidity of action.
5. The supply of ammunition is regular.
6. The principle of the extraction is very good. The committee are unable to see any disadvantages inherent in the system." . . . . . .

The committee consider that the Nordenfeldt system has the following advantages:

" 1. Its mechanism is fairly simple.

2. Its component parts are replaced with facility and are easily accessible.

3. The system is practically one of volley firing.

4. The position of the firer is suitable for laying and firing simultaneously, except at high angles of elevation.

5. A failure to extract in any one barrel does not necessarily put the others out of action.

The following are the chief disadvantages:

1. The horizontal motion of the handle is not one that can be kept up for a length of time without fatigue. . . . . .

2. The extraction of all the cartridges being simultaneous, requires the exertion of unusual and varying degrees of force, and increases the liability to pull the extracter through the rim of the cartridge. . . . . .

3. The present feed of the Nordenfeldt is not good; the feed cases require careful filling. If a cartridge falls vertically in the feed unobserved, it may fall in the same position into the action and cause a jam. . . . . .

4. Should a hang-fire take place, causing an explosion in the action, the effects would probably be more serious than with other systems where the cartridges in the feed are not confined. . . . . . .

5. The amount of pause is dependent on the movement of the arm of the firer, and has not, therefore, been accurately determined, but has been estimated at about one-twelfth of a second, when firing at the most rapid rate.

6. If the lever is not drawn back to the full extent, the springs are not compressed, and the next volley is dropped unfired from the gun."

ON THE CORROSIVE EFFECTS OF STEEL ON IRON IN SALT WATER.

[*Engineering*, April 7, 1882.]

Mr. Farquharson presented a paper on this subject at the 23d Session of the Institution of Naval Architects, and recalling the fact that this subject had attracted some attention last year, and that some particulars had been furnished of actual cases of rapid corrosion, he said that the facts then cited were rather suggestive than conclusive, that its origin was the steel combination, as there are other known causes of equally rapid corrosion where no steel is present. Large iron forgings, besides being liable to external influences, contain within themselves elements of decay as rapid as any then noticed. Such forgings are made up of numerous smaller ones, and after being welded up into one whole, they contain more or less magnetic oxide, which is as destructive as a like quantity of copper would be if placed in its stead; the well-known fissures or deep seams, which appear more or less in all rolled or forged iron when corroded by salt water, are wholly due to this cause. In experiments made two or three years ago with mild steel, it was shown that pitting ensued from the presence of oxide or scale in the presence of salt water. The experiments to be described were undertaken with a full knowledge of these facts. Hence care was taken that both the iron and the steel plates should be perfectly clean. Plates two feet square were taken, cleaned and weighed, and placed in a wooden frame parallel and one inch apart, iron and steel alternating. In three cases the pairs of steel and iron were coupled together. The whole series were sunk in Portsmouth harbor for six months, and at the end of that time raised and weighed. The three iron plates, which were coupled, lost 21 oz. 57 grs., the three uncoupled iron plates lost 11 oz. 137 grs. The three coupled steel plates lost 4 oz. 187 grs., the three uncoupled steel plates lost 12 oz. 60 grs. The plates were all cut from the same piece. After discussing these results at length, the writer says the main object of this experiment was to test the effects of combinations of iron and steel, and the lesson taught is either to avoid altogether such combinations, or to so modify the conditions as to minimize the injury to the iron, but these experiments throw light also on the still more important question of the relative endurance of iron and steel, and show that their endurance is practically the same when alone. A careful examination of the steel used in this and other cases showed that it was not homogeneous on account of imperfect mixing. With a thoroughly homogeneous steel, it is believed that its endurance will be far superior to the best iron.

REVIEWS.

No publication will be noticed under this head, unless a copy, to be placed in the Institute Library, is sent to the Corresponding Secretary at Annapolis, Md.

EGYPTIAN OBELISKS. By Lieut. Comd'r H. H. Gorringe, U. S. Navy. Press of G. P. Putnam's Sons, New York.

In this elegant volume Lieut. Comd'r Gorringe gives a full account of the details of the transportation of Cleopatra's Needle from Alexandria to New York, accompanying his description of the various trials encountered and overcome, with photographic views and plans illustrating every stage of the undertaking. No more fitting memorial of the transfer of one of the most interesting monuments of antiquity to our shores, could be made than we have in this volume, but it is also a certificate to the zeal, untiring energy and engineering skill of naval officers in a field foreign to their profession, and as such, is of special interest. The story of the removal is too well known to require any rehearsal. The engineering problem encountered was the removal of an obelisk, weighing 220 tons, from its pedestal, weighing 30 tons, and the safe transportation and erection of both in New York. This, in itself, was sufficient to call for the highest skill, but its operation was encumbered by numberless difficulties arising from the jealousy and ill-will of the European residents of Alexandria; and in the management of these complications, the greatest tact and good management were displayed. "The vicious obstruction of Europeans failed to retard the work, and had no other effect than to increase the cost of its execution."

One complication, however, which might have proved very embarrassing, cannot be laid elsewhere than at our own doors. An American officer is sent abroad to carry out a public work, taking with him the necessary papers from the Secretary of State, to show that he is officially accredited "on the part of the government of the United States, and as its representative, to receive and remove the obelisk." In the execution of this undertaking it was necessary to purchase a steamer, the "Dessoug." Here Lieut. Comd'r Gorringe says :

"The nationality of the 'Dessoug' was a delicate question to settle. Under the laws of the United States she could not be registered as an American vessel. Sailing under the Egyptian flag would have involved serious risks and embarrassments, especially in connection with the crew. The British, or other European flag, would have been more objectionable from every standpoint, especially in the evasion of laws relating to ownership. There was no other course than open defiance of law, which the circumstances fully justified; and

I determined to make the voyage from Alexandria to New York without registry or nationality, thereby taking the risk of having my steamer seized by any vessel of war at sea, or by the authorities of any port I might be obliged to touch at." Although the voyage was attended with accidents, a serious one being the breaking of the shaft, fortunately nothing occurred to call the legal status of the ship into question.

To the record of the incidents of the transfer, Lieut. Comd'r Gorringe adds a chapter on the archæology of the New York obelisk, and Lieut. Schroeder gives detailed accounts of the engineering operations involved in the removal of the London, Paris and Vatican obelisks, illustrated with careful drawings and plans. A comparison of these methods, with that used in the removal of the New York obelisk, seems to be greatly in favor of the latter, as regards simplicity, certainty and safety. A chapter gives the record of all Egyptian obelisks, containing many valuable and interesting historical data collected from all available sources. The subject is not thought to be thoroughly treated, without a discussion of the granite of which the obelisk is made, and this is examined in the same spirit of thoroughness that is shown on every page of the work.

The book is most interesting, although treating principally of what would naturally be thought technical details. Lieut. Comd'r Gorringe tells the story of the removal modestly and tersely, but through his whole account can be seen the sense of responsibility he felt in his novel field of action. Lieut. Schroeder's portion shows careful study and investigation, and is full of historical information which is new to the general reader. The distinctive feature of the volume is found in its full-page artotype illustrations, portraying every step of the work, and contributing greatly to render it interesting as well as valuable to the reader or student.

The International Scientists' Directory. 391 pp., 16mo. S. E. Cassino: Boston, 1882. Price $2.00.

Among the devices for saving time and facilitating intercourse between men in these modern, busy days, the directory holds an important, though humble, place. First invented for the use of commerce, its convenience has commended it to the men of other professions, and its application has been continually extended. The work before us is the result of six years' growth. Beginning as an annual record of the men of science in the United States, it has developed into an international register, and it now contains names, addresses, and pursuits of the scientists of the world. Its fullness is shown by the fact that 128 pages are devoted to the United States and Canada, sixty-four to Great Britain, forty-three to France, twenty-seven to Germany, eleven to Italy, and nine to Sweden. Its breadth is shown in that it embraces countries as remote as Australia and Antigua, Burmah and Brazil, Gambia and Guadeloupe, Yoruba and Zanzibar. The preparation of a book of this nature involves an immense deal of labor, and we congratulate the editor upon the thoroughness with which it has been done.

BIBLIOGRAPHIC NOTICES.

ANNALEN DER HYDROGRAPHIE U. MARITIMEN METEOROLOGIE. 1882.

PART I. Notice of the researches of A. Colding on the storm flood from the 12th to 14th of November, 1872, in the Baltic Sea. A remarkable storm occurring October 14th and 15th, 1881. Consideration of the method and table of Elford, or the so-called Niger Table. (Attention has been called to the interest felt in this table of lunar distances in Germany, France and Italy, in the last number of the Proceedings.) Estimation of the deviations coefficient through the observation of the horizontal strength. River and harbor of São Francisco, Brazil, from the log-book of S. M. S. Victoria. Entries on the meteorological journal of the German naval observatory for September, 1881. Comparison of the weather of North America and Central Europe for October, 1881. Brief hydrographic notices. Tables of meteorological and magnetic observations for December, 1881.

PART II. Tidal phenomena in the Gulf of Tonquin and the China sea. Determination of the paths of cyclones through normal points. Notes from the log-book of S. M. Kbt. Wolf. Entries in the meteorological journal of the German naval observatory for October, 1881. San Diego and the coast of California. Deep sea sounding in the Pacific Ocean and Gulf of California, by Capt. Belknap on the Alaska, and Comdr. Philip on the Ranger. Comparison of the weather for November, 1881, in North America and Central Europe. Brief hydrographic notices. Tables of meteorological and magnetic observations for January, 1882.

PART III. Results of the recent deep sea investigations in the Arctic Ocean. Normal points for the typhoons in the Chinese and Japanese seas for 1881. Contribution to the knowledge of the climate of the east coast of Africa. Upon the weather of New Britain from January to March, 1881. Comparison of the weather for the month of December and the year 1881 in North America and Central Europe. Log notes, hydrographic notices, and meteorological tables as usual.

PART IV. The deep sea investigations in the Arctic Ocean continued. Statistics of the weather of the North Atlantic Ocean during 1880. Relations of a fall of pressure between the upper and lower winds to the cloud forms which result from it. Comparison of the weather of North America and Central Europe for January, 1882. Log notes, hydrographic notices and meteorological tables as usual.

AMERICAN SOCIETY OF CIVIL ENGINEERS.

DECEMBER, 1881. Standard time.

A synopsis of the steps taken by different societies and individuals toward the adoption of a uniform system of time. Recommends the adoption of twenty-four standard meridians, differing from each other one hour in time, and the division of the day into twenty-four hours, instead of two divisions of twelve hours each.

JANUARY, 1882. Report of Committee on the above subject.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

1881. Papers read at regular meetings. Most economical point of cut-off in steam engines. Proper method of expansion of steam and regulation of the engine. Counter-balancing of engines and other machinery having reciprocating parts. Our progress in mechanical engineering (President's address). On the ratio of expansion at maximum efficiency. Discussion on same. Standard measurements. Latest methods of submarine telegraph work.

REPORT OF CHIEF OF BUREAU OF STATISTICS, 1881.

The following comparison can be made between the state of the mercantile marine in 1881 and the figures for 1880, given in the prize essays for this year:

	1881.	1880.
Exports, ...	$902,337,346	$835,638,658
Imports, ...	642,664,628	667,954,746
Total imports and exports in American vessels,	268,080,603	280,005,846
" " " " " foreign "	1,378,556,017	1,309,466,596
Registered tonnage, American, ...	1,297,035	1,314,402
Total " " . . .	4,057,734	4,068,034
Tonnage entered in foreign trade, American, .	2,919,149	3,140,169
" " " " " foreign, .	12,711,932	12,112,160

This exhibit shows in every item a loss for American and a gain for foreign shipping, while the total trade of the country is greater than ever before.

ENGINEER.

FEBRUARY 10, 1882. Kelway's Electric Log.

A small propeller is enclosed in a casing projecting below the ship's bottom, and is caused to revolve by the resistance offered by the water to the ship's headway. By suitable gearing, a chain of wheels is set in motion, one of which having eight ratchet teeth moves a lever closing an electric circuit eight times while the ship passes over a mile. The current works a needle on a dial registering the speed.

MARCH 3. Pintsch's System of Lighting Buoys, Light-ships, etc.

By distillation of paraffine or other hydrocarbons, a gas is obtained which remains permanent at a pressure of ten atmospheres. It is forced into buoys at this pressure, and burned under its own pressure in a lantern on top of the buoy, the flow being controlled by a patent regulator.

MARCH 10. Sea-going Yarrow Torpedo Boats for the Argentine Confederation.

Made the passage from England to Buenos Ayres under sail.

APRIL 21. Steam Steering Gear at the Naval and Submarine Exhibition.

MAY 5. Berthon Collapsible Boat.

The boat is built with longitudinal frames jointed at stem and stern, so as to be easily folded into a small bulk. The frames are covered with two canvas skins, one external and the other internal, and the space between is divided into water-tight compartments. Braces secure rigidity when used. Boats of this type are used by British troopships, and to some extent in the Royal Navy. They are also used aboard torpedo vessels in the French, Italian and Greek navies.

ENGINEERING.

FEBRUARY 17, 1882. Pilsen Electric Light.

FEBRUARY 24. Gramme Regulator. Gramme Dynamo-machine driven by Brotherhood Engine for Naval Use. Transmission of Power by Electricity.

M. Marcel Deprez obtained a return of twenty-five per cent. of the work of a Gramme machine through a resistance equal to that of fifty miles of ordinary telegraph wire.

Thornycraft Torpedo Boat for the Danish Government.

Displacement 55 tons. Carries coal for 1200 miles, steaming at eleven knots. On trial trip the average of a number of runs was 19.91 knots. Armed with four large Whitehead torpedoes.

MARCH 17. Schückert Dynamo-Machine.

MARCH 24. Burton Magazine Rifle.

Comparisons are made between the British regulation arm, the Martini-Henry, and those in use by other European powers, greatly to the detriment of the former.

As an illustration of the commerce, the "commerce-chasers" of the immediate future will have to deal with can be cited the new China clipper "Stirling Castle." In the trial trips on the Clyde, the highest speed obtained on the measured mile was 18.75 knots. Mean of six different trials 18.418 knots.

MARCH 31. Electric Lighthouses of France (continued from March 17). Marine Boiler Construction.

Armored Ships and Modern Guns.

A criticism by J. D'A. Samuda of Sir Wm. Armstrong's address before the Institution of Naval Architects.

An editorial on the same subject states: "that a general return to unarmored or 'freely penetrable' ships would lead to the arming of vessels with numerous guns that would fire shells with very heavy bursting charges. These guns would be such as would be able to place the maximum of explosive materials in the interiors of 'freely penetrable' ships in the minimum of time, and would rapidly kill and demoralize the crews and disable the fighting appliances."

APRIL 7. Exhibits at the Naval and Submarine Exhibition. H. M. S. Edinburgh and Colossus. Cunard Steamer Servia.

APRIL 21. Incandescence Arc Lamps. Halpin's Compound Engine.

Trials made at works of Messrs. Manlove, Alliott, Fryer & Co., at Nottingham. Two trials of eight hours each were made on March 1st and March 15th, respectively. Mean quantity of coal burnt per hour per indicated H. P. 1.6 lbs. in the first trial and 1.8 in the second.

Yarrow Torpedo Boat for the Italian Government.

Mean speed obtained on official trial, 22.46 knots. A peculiar feature is that the ash-pan is extended up around the fire-room to above water level on all sides, so that leakage from the fire of machine guns or from other causes would not extinguish the fires.

APRIL 28. Hydraulic Gun Carriages. Experiments with Deflecting Armor.

Experiments at Portsmouth on 3 in. and 4 in. plates were highly satisfactory at 10 degrees, the 12 ton gun being used.

Krupp's Muzzle Pivoting Gun.

The 21 cm. gun has been tested for gunboat use. The vessels are intended to be fast, handy and of light draught, each carrying one gun, pivoted at the muzzle in a framework extending down to the keelson. The design is to use torpedo shells calculated to explode after penetrating some distance into the armor plating. A few of these gunboats could make a serious attack against any ironclad afloat.

FRANKLIN INSTITUTE JOURNAL.

MAY AND JUNE, 1882. On the Several Efficiencies of the Steam Engine. R. H. Thurston.

GIORNALE DI ARTIGLIERIA É GENIO.

DECEMBER, 1881. Portable forge and bridge material for field batteries. Disinfection by nitrous anhydride and ethyl nitrite. Report of experiments on shrapnel and canister for the 12 cm. and 15 cm. breechloading guns. Weldon's prismatic telemeter. Effective force of German field artillery. Belgian siege gun carriages. French pontoon trains. Organization of the French corps of Engineers.

JANUARY, 1882. Reflecting telemeters of Weldon, Azemar, Pratt and Watkin. The varnishing and painting of artillery material. Photography by means of gelatino-bromide of silver. Discussion of the curve of frequency of accidental errors. Reorganization of the schools of artillery and engineering in France. Tests of the Le Boulengé telemeter in Germany. Steel containing silica and manganese for musket barrels.

FEBRUARY, 1882. The new material for the 9 cm. gun. Construction of firearms in Italian foundries. Russian experiments firing on field redoubts. Can fortresses be taken by assault? The fortifications of Strasburg and Metz. Crane for lifting 150 tons at Cronstadt.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS.

FEBRUARY, 1882.—Comparative Efficiency of Non-conducting Coverings for Steam Pipes.

Silicate cotton, made by forcing steam or air through molten furnace-slag, gave most economical results, highest efficiency being given by Toope's patent covering, made of layers of asbestos, hair-felt, and compressed paper.

Swan's incandescent lamp fitted to small cells of secondary battery, for use in dangerous mines. The cells were charged outside the mine and then transported where needed. The idea is to avoid the danger that might result from the spark incident to any breaking of the conductors.

INSTITUTION OF MECHANICAL ENGINEERS.

JANUARY 18, 1882.—Bazin System of Dredging, as in use at Lowestoft, England. Hydraulic Lifts. Riveted Joints. Experiments on High-bearing Pressures, Series X.

JOURNAL DE LA FLOTTE.

JANUARY 15, 1882.—Naval Savings-banks in the English Navy. Torpedoes at the Paris Electrical Exhibition. Electrical Telemeters of Le Goarant de Tremolin and Siemens and Halske.

These telemeters are similar in principle, each requiring two observers at the ends of a base-line, who keep telescopes continually directed at an enemy's ship in the offing. By an electrical apparatus, small rulers on a plane table are kept constantly parallel to the telescopes respectively, and the position of the ship is thus shown at a glance relatively to the fixed torpedoes in the channel. On its approaching sufficiently near to any one, the officer in charge at the plane table can explode it with certainty.

JANUARY 22.—The "Ting Yuen," built in France for the Chinese Government.

Displacement 7430. H. P. indicated 6200. Armament, four Krupp guns of 30.5 and 25 cm., two of 15 cm., and eight revolving cannon. Fitted also with torpedo tubes for Whitehead torpedoes.

MARCH 5.—New Sounding Apparatus.

A metallic balloon is made so as to float in sea water. To the bottom is fixed a mass of ballast of sufficient weight to cause it to sink to great depths. On touching the bottom the ballast is released, and the float rises to the surface, where it is recovered. The depth is registered, as in other patent leads, by a revolving wheel and appropriate gearing.

MARCH 12.—Cost of German Ironclads.

Koenig Wilhelm,	10,102,829	marks.	Friedrich Karl, .	6,453,296	marks.
Deutschland, . .	8,240,450	"	Kronprinz, . .	6,296,721	"
Kaiser, . .	8,226,032	"	Sachsen, . .	7,803,475	"
Frederick der Grosse,	7,303,417	"	Bayern, . . .	6,930,339	"
Preussen, . .	7,038,097	"			

The mark is nearly equal to 23 cents.

Repairs additional, Koenig Wilhelm, 1,962,156 marks; Friedrich Karl, 2,265,090 marks; Kronprinz, 1,221,965 marks.

APRIL 16.—Machine Guns for Torpedo Boat Attacks.

"It is admitted in all navies that the attacks of torpedo boats against ships will never be made in full daylight, but at night, and preferably in rainy or foggy weather. It is acknowledged that, in such conditions of the attack, a torpedo boat would not be seen from a ship until within a distance of about 400 metres. It is extremely likely, moreover, bearing in mind the speed of the torpedo boat, that if once within 100 metres of the ship, it would reach it, whatever the means of defence. There is, then, a space of about 300 metres, that between 100 and 400 metres from the ship, in which every effort must be made to sink the torpedo boat under penalty of being sunk by her.

The problem of the defence of ships against torpedo boats consists, then, in finding a gun that can throw, under the conditions of distance that have been named, the greatest possible number of projectiles while the torpedo boat is passing over the 300 metres. Assuming its velocity to be about twenty knots an hour, it is seen that there would not be more than twenty or thirty seconds for defence, and during this short space of time the greatest number of pro-

jectiles, having sufficient penetration to pierce the sides, boilers, and water-tight bulkheads of the boat, should be thrown upon its path.

The experiments at Gavre show that the Nordenfeldt gun can fire in ten seconds forty steel projectiles, with great accuracy, with an initial velocity of 460 metres, and two magazines containing eighty, in about thirty seconds. The shot can pierce, at ordinary distances, steel plates of 20 mm. and iron plates of 25 mm., at an angle of incidence of 30°."

MAY 7.—M. Mascart, in a communication to l'Academie des Sciences, calls attention to the recent magnetic storms in France. Oscillations occurred having an amplitude of 6′ on April 6th, 7th, and 8th, of 10′ on April 16th, and of 25′ on April 20th. Simultaneous observations of atmospheric registers failed to indicate any perturbations.

It will be remembered that the aurora of April 16 was one of the most remarkable ever seen in this country, and that on that night telegraph lines were worked in many sections of the Northern States without batteries.

MITTHEILUNGEN AUS DEM GEBIETE DES SEEWESENS.

VOL. X, NOS. I and II.

The automatic floating gate for the new dry dock at Pola. The budget of the German Imperial navy for the official year 1882–1883. Chronometer studies No. 10 (continued). Steam launch of the Imperial German navy for projecting Whitehead torpedoes. Remarks on the latest transatlantic steamships. Notes on the English, Italian and United States navies. Departure of the Russian meteorological observation expedition for the mouth of the Lena. The share to be taken by Germany in the international Polar investigation. Theory of control compasses and their azimuth errors, with a consideration of the mean deviation of ordinary compasses. This number also contains a valuable series of tables of meteorological and magnetic observations for 1881.

NORTH AMERICAN REVIEW.

MAY, 1882. Our Navy. Lieut. Comd'r H. H. Gorringe.

RIVISTA MARITTIMA.

JANUARY, 1882. Reflections on naval tactics. The naval appropriations. The Melbourne telescope. The tactics of ramming. Types of English ironclads, 1860–81. Illumination of the port of Havre by electricity. Steam navigation in China.

FEBRUARY. Reflections on naval tactics (continued). The naval appropriations (continued). Magnaghi's new liquid compass. Calculations for the difference of immersion when a compartment is full of water. English ironclads (continued). Organization and administration of the crews of the Italian navy. Report of the Naval Advisory Board of the United States in reference to the material of the navy.

MARCH. Reflections on naval tactics (continued). The naval appropriations (continued). Deep sea work of the "Washington," season of 1881. Torpedoes and naval wars. The dynamograph of the marine engine. Experiments with armored ships in Russia.

APRIL. Reflections on naval tactics (continued). The naval appropriations (continued). Defence of the Italian coast. Magnaghi's compass (concluded). Torpedoes and naval wars. Sir Wm. Armstrong's address.

REVISTA GENERAL DE MARINA.

JANUARY, 1882. Suggestions for steam trials of men-of-war. Torpedoes in the English Mediterranean squadron. System of absolute and electrical units. The gun explosion aboard the Tornado. The British ironclad fleet (translation).

FEBRUARY. Torpedoes of the Dutch navy. The Aragon. Types of naval vessels. Progress of naval artillery between 1855–1880. The use of machine guns in battle. Steam trials of men-of-war (continued). The British ironclad fleet (continued).

MARCH. Steam trials of men-of-war (continued). Use of machine guns in battle (continued). The explosion aboard the Tornado. Naval organization. Progress of naval artillery (continued). Sir Wm. Armstrong's address on the defences of England (trans.).

APRIL. Steams trials of men-of-war (concluded). Naval and mercantile marines. The 6 in. Armstrong gun. English experiments with machine guns. The explosion aboard the Tornado. Progress of naval artillery between 1855–1880 (continued).

MEMOIRES DE LA SOCIÉTÉ DES INGÉNIEURS CIVILS.

DECEMBER, 1881.—Séances-Visites to the Electrical Exposition is a continuation of these readable reports of the Exhibition. This instalment is devoted entirely to the consideration of dynamo and magneto-electric machines.

JANUARY, 1882.—Valves for the Prevention of Boiler Explosions. These valves, constructed on the system of M. Barbé, consist of a reversed safety valve set on the body of the boiler. In six experiments when water was fed into boilers carried to a red heat no explosion ensued.

Anti-Incrustator for Boilers.

This consists in the introduction of 500 grams of thick oil to every 1000 litres of water once each month. The result is that calcareous and other salts are precipitated to the bottom of the boilers in the state of a non-adherent mud.

ROYAL UNITED SERVICE INSTITUTION.

No. CXIII. Electricity at the Paris Exhibition as applied to military work.

No. CXIV. On signalling and conveying the orders of a commander-in-chief in action. Machine guns, and how to use them. Fog signals for ocean navigation. Ship clinometers.

Attack of Armor-clad Vessels by Artillery.

In this paper Capt. Browne divides the attack into three kinds, viz. primary and secondary attacks and attack of decks. The primary attack is that made against the vital parts of the ship, and presupposes the possession of guns capable of piercing the enemy's armor, the thickness of which is supposed to be known. Whether this can be done or not is determined by a simple rule for penetration in wrought iron: "one calibre thickness of armor for every thousand feet of velocity." Tabulated experimental results are given, showing that this rule is approximately correct.

The attack of decks, "when practicable, is probably the most formidable of all, but may be attempted with guns incapable of piercing side armor." The experiments at Meppen in 1879 showed that great accuracy was obtainable at

high elevations, or with mortar fire, if a vessel was at anchor or nearly stationary. A horizontal target, 100 m. long and 25 m. wide, representing a ship's deck, was placed bows towards the firing point, and fired at with the 11 in. howitzer at a range of 6700 m., five shell out of ten fired striking the target, the last four close together.

Secondary attacks are made with ordinary projectiles against the unarmored portions of the ship. In some recent vessels the battery is not protected by thick armor, and attention is called to experiments showing that in such cases common shell or even shrapnel are very effective against guns and personnel. All vessels now built have some parts not protected by armor, and the secondary attack would be made against these, probably with the idea that leakage or fire might cause positive injury, although the battery and machinery remained intact.

Of late attention has been called to the attack of even the heaviest ironclads by a number of small gunboats, each carrying a single heavy gun. "The spectacle of the 'Inflexible' attacked by half a dozen such boats, and defending herself with her two pairs of 80 ton guns, and her necessarily limited supply of ammunition, would afford a painful illustration of power awkwardly employed. I think she would feel the need of the medium new type guns which I have advocated in such a case." In the discussion following the article, Vice Admiral Selwyn says, "I want to point out what an enormous advantage it would be to this country if these large guns could be set afloat on moderate sized and moderate drafted vessels, in such numbers that we could have a great many of them in each port. I would not confine myself to one or two; I should say ten, carrying each the heaviest gun that can be put afloat. There is no reason why you should not do this; it is perfectly possible. If you will consider that we might have twenty such vessels with twenty 80 ton guns, to go to the attack of one ironclad coming in with four 80 ton guns, I think, as she can only fire those four 80 ton guns at four out of the twenty ships at a time, she will be very thoroughly punished before she gets rid of her mosquito antagonists."

No. CXV. Naval prize essay. "The best method of providing an efficient force of officers and men for the navy, including the reserves," by Capt. Brine, R. N. Naval Education.

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NAVAL INSTITUTE PRIZE ESSAY, 1883.

A Prize of one hundred dollars and a gold medal of the value of fifty dollars, is offered by the Naval Institute for the best Essay presented, subject to the following rules :

1. Competition for the Prize is open to all members, and to all persons entitled to become members upon payment of dues ; that is, to all officers of the Navy and Marine Corps, and to all civil officers attached to the Naval service. But members who have been dropped for non-payment of dues are not eligible for membership until their arrears of dues have been made good.

2. Each competitor to send his essay in a sealed envelope to the Secretary on or before January 1, 1883. The name of the writer shall not be given in this envelope, but instead thereof a motto. Accompanying the essay a separate sealed envelope will be sent to the Secretary, with the motto on the outside and writer's name and motto inside. This envelope is not to be opened until after the decision of the Judges.

3. The Judges to be three gentlemen of eminent professional attainments, to be selected by the Executive Committee, who will be requested to designate the essay, if any, worthy of the Prize, and, also, those deserving honorable mention, in the order of their merit.

4. The successful essay to be published in the Proceedings of the Institute, and the essays of other competitors, receiving honorable mention, to be published also, at the discretion of the Executive Committee.

5. Any essay not having received honorable mention, to be published only with the consent of the author.

6. The subject for the Prize Essay is, "*How may the Sphere of Usefulness of Naval Officers be Extended in Time of Peace with Advantage to the Country and the Naval Service?*"

7. The Essay is limited to forty-eight printed pages of the "Proceedings of the Institute."

8. The money value of the medal may be given to the successful competitor if he so elect, and he will be made a Life Member of the Institute.

CHAS. M. THOMAS,
Secretary.

ANNAPOLIS, MD., *March* 9, 1882.